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SEE-SAW EXPORTING.

One of the great difficulties experienced by this country in building up export trade lies in the fact that many who seek such trade are not persistent in their efforts. During "boom" periods of prosperity, such as this country has been enoying for five or six years, the domestic demand for many goods outruns the capacity of production, so that little incentive exists to look up markets abroad. Hence, export trade and all who try to promote it, have a rather hard time, and much of the previous effort is wasted. Then comes a period when production has caught up with consumption, or when demand at home has slackened, and at once the manufacturer we have in mind is keenly ready for all the foreign trade he can get, and wonders why it does not all come back his way at once. But he ought to realize that persistency counts for something, and that while he has been withdrawing from neutral foreign markets, his competitors abroad have not been idle, but have strengthened their connections, accustomed the public to certain styles and brands of goods, and learned pretty much all there is to know about the best conditions of selling.

We look for a period of renewed activity in export trade, including that in general electrical supplies and apparatus, but desire to point out that the business is not to be caught or won back as easily as some people imagine. It is fortunate, so far as electrical goods are concerned, that American styles and methods are among the most popular, and can hold their own anywhere; but no small amount of effort has yet to be expended in cultivation of the field. The article by Mr. Gerssel, in this issue, on Egypt, is a case in point. Probably many of our readers never thought of Egypt as a market, but few could read this article or become familiar with present development along the Nile without believing that in a country where American engineering apparatus is already so favorably known, excellent opportunities ought to be found by manufacturers in various lines. And what is true of Egypt is true of other countries.

RESIDUAL CHARGES OF CONDENSERS.

On page 562 of this issue is a brief article by Mr. J. J. Cort on the subject of residual charges of condensers. This phenomenon was first discovered in connection with Leyden jars about a century ago, and much research and attention have since been devoted to it. There is a compendious literature upon the subject bulky with mathematical theories. Nevertheless, the existing theory is by no means completely satisfactory, and contributions of precision on this subject are always welcome. The curve accompanying Mr. Cort's article refers to the residual charges in a two-microfarad condenser, the dielectric of which does not seem to be mentioned. We find that within the limits of the diagram this curve is very closely represented by the formula:

$$D = 2.43 \log_e t\,(1 + 0.00231\,t) \quad \text{. . . . divisions,}$$

where D is the number of scale-divisions and t the elapsed time in seconds. The agreement between this particular formula and Mr. Cort's curve of observations seems to be within about one per cent. at all points of observation. In ordinary language Mr. Cort's curve of residual quantity is practically a logarithmic function of the time of accumulation and increased in a linear ratio with the time, or increased according to a straight-line law. It would be interesting to have a series of such curves prepared under definitely varied elec-

trical conditions to see whether the same formula would continue to apply.

The Coming Institute Year.

Following the example of retiring President C. F. Scott, Mr. Bion J. Arnold, at the beginning last Friday of his term of office as president of the American Institute of Electrical Engineers, outlined briefly the policy which he considered should guide the Institute during the coming year. While at no time could it be charged that the Institute had seriously lagged in its duty to the profession for which it stands, yet for some years its rate of growth had not corresponded to the rate of increase numerically of the profession. During the past two years, however, there has been a remarkable increase in membership, which is to be ascribed to a number of causes. Among these, aside from the influence of the great wave of prosperity which has been passing over the country, and the vigorous policy, of which we shall speak later, of the last two presiding officers, were the attention attracted to the Institute by the very successful Conversazione in 1901, and the Kelvin, Marconi and Library dinners; the foundation of the Institute Library by the gift of Dr. Wheeler and Mr. Carnegie, and its subsequent phenomenal growth through the generosity of members; and the conspicuous part played by Institute officers and members in the negotiations leading to Mr. Carnegie's gift of one million dollars for a union engineering building. But perhaps the greatest impetus was derived from the change of policy instituted by President Steinmetz and continued by President Scott with respect to the paper programme, and the inauguration by the latter of numerous local meetings throughout the country. In addition are several other commendable features introduced by President Scott, having for an object to increase the value of the Institute to its members, and thus tending to attract adhesions to the body.

The great extension of the activity of the Institute entailed by the increase in membership and the various new measures instituted, has naturally very greatly increased the expense of conducting the body. While the income has more than doubled—growing from $13,617 for the year ending April 30, 1901, to $30,181 for the year ending April 30, 1902—the report for the latter period showed a credit balance of but $621 for the year's operations, notwithstanding that all accounts receivable are credited as assets and no accounts payable appear debited to liabilities. In the same period the membership grew from 1,260 to 2,229, and as Mr. Arnold stated in his remarks, it is improbable that this rate of increase can be maintained. Consequently, the situation that the new president has to meet is a probable decrease in rate of growth of membership, with perhaps an actual decrease should a period of industrial depression occur; and a necessity for checking expenses so that a safe balance will be assured at the end of the year's operations. The remarks of President Arnold indicate that he recognizes this situation, and it is fortunate for the Institute that its new presiding officer, besides being an eminent engineer, is also a thorough business man, and thus qualified to put the Institute in the securest possible position with the least possible slackening of its activities, should any sacrifice be indicated—which all will sincerely hope will not occur. The administrations of Messrs. Steinmetz and Scott will always be memorable as periods of great constructive work. We are sure that none of their predecessors can regard this work with other than pride and gratification, since it came to crown as a stately structure the foundations they had laid so faithfully and laboriously. While the new era entails for the succeeding presidents greater burdens and responsibilities than any heretofore dealt with, the incumbents of the office will prove equal to them.

Speed Extraordinary.

Recent reports from the tests of high-speed electric cars on the Berlin-Zossen line indicate that the experimenters have achieved a signal success. As our readers will probably remember, the previous series of tests was a distinct success, but that at speeds above 80 to 90 miles per hour the track began to show serious weakness; and that for this reason the highest speed attempted was a small fraction short of 100 miles per hour, instead of the 125 miles per hour, which was the goal toward which the experimenters were working. On the other hand, the electrical part of the equipment worked admirably, and it was effectually shown that the power allowed for the work in the motors was ample. It was found that the contact devices did their work well at the highest speed attempted, and that the air resistance, concerning which direful predictions had been made, was well within the limits allowed for in planning the work. Resuming work now after an interval of about two years, on a roadbed in suitable condition, the experimenters started in a couple of weeks ago at about 90 miles per hour and have raised the speed from time to time until the unparalleled rate of over 117 miles per hour is stated to have been reached, without developing weakness of car equipments or of track. Although the tests have been interrupted by the need of using the military road for its proper purpose for a few days, they will soon be resumed and the engineers have full confidence that the 125 miles per hour originally planned will be reached without difficulty. We wish to add that we shall be somewhat surprised if even this immense speed is not surpassed.

This latest achievement is most noteworthy. The car reached a speed considerably higher than any moving body short of a projectile had previously attained, if we possibly except the maximum rates touched by Mr. O. T. Crosby in one of the runs at Baltimore with the Weems experimental cigar-shaped car in 1891. That car, however, carried no passengers and wrecked the track before its speed could be definitely determined on its last fateful run. There is a single record of about 108 miles per hour for a steam locomotive, and there are numerous locomotive records a little short of 100 miles per hour. The Zossen mark, however, stands in a class by itself, and while it will probably stand only until the resumption of the tests it is a fine demonstration of what the present century may see in the way of rapid transportation. Great credit is due to the German engineers who conceived the plans and have carefully and with characteristic Teutonic patience carried them through to brilliant success. The deliberate formation of a syndicate to thresh out the details of a great technical problem was itself a thoroughly characteristic measure which quite deserved the success it has met, and it is hard to say too much of the skill which has been displayed. We extend most hearty congratulations and best wishes for 150 miles per hour. We have persistently expressed our belief in the feasibility of these very high speeds, and have had very small sympathy with the efforts that some have made to throw cold water upon the scheme. It is all very well to belittle such experiments and damn them with faint praise as theoretical and uncommercial; but the fact now stares us in the face that these patient and clever German engineers have actually done the thing at which Yankee enterprise has shied. True enough, there has been a small group of American engineers which has stood firmly out for the feasibility of the work, and which has been ready at any time within the last decade to undertake it, but the American high-speed plans have failed for the lack of support, and the first laurels have fallen to others.

Whether American enterprise will allow this defeat to be "rubbed in" by the construction of a German commercial high-speed road before we get around to doing anything on this side of the water, is now the question before the house. There is no doubt that Germany is

in the position of vantage at present, and that it is an easier field in which to operate. For the German railroads are under government direction, and if the German Emperor, than whom no Yankee was ever more alert and keen-sighted, gives the word, the enterprise will go through. If rumor is to be given credit, the Berlin-Zossen experiments were really instituted to awaken an interest in the highest governmental circles which would, at the proper moment, more than neutralize anticipated bureaucratic opposition to an electric express line between Berlin and Hamburg. Here, where the railways are in private hands and combined into huge groups, with elaborate devices for "dividing the spoils" between them, any attempt to disturb the concert of the magnates by the inauguration of high-speed service would, it is to be feared, be repelled with violence, and there would be no appeal to a higher power. The almoners of the great systems would get busy at once and a franchise would be obtained, if at all, only at the cost of indefinite cash and interminable legal proceedings. A high-speed road must be, as we have several times pointed out, of considerable length in order to realize the full advantages of speed, and the task of obtaining rights would thus be doubly formidable. There seems, too, to be an impression current among American engineers that we may gradually work up to great speeds along the line of progress taken by our present interurban systems. The public frequently hears of plans for 60 or 70 miles per hour, but we are strongly under the impression that these will simmer down to more modest figures when total running time is considered. The methods now in vogue are not suited to the ready development of the hundred-mile-an-hour train, and suburban service is not the place to develop it. There is a great gulf fixed between a maximum speed of 70 miles per hour between stations and a schedule speed half as great again over a long run. This latter is the goal at which our German friends are aiming, and they have made a good start. Is American enterprise staggered at the proposition, or does it fear to tread in the path the Germans have blazed? For the credit of our country and century we hope not.

THE ELECTROLYSIS OF WATER.

An interesting paper on this subject was read by Prof. Richards and W. S. Landis, before the American Electrochemical Society at its recent meeting in Niagara Falls, the paper forming a sequel to a predecessor read last April. Much discussion has taken place during the last few decades as to the nature of the conduction of water. A complete understanding of the subject would entail a complete knowledge of the nature of electricity and of matter; but at present all we can hope for is a working hypothesis which will reconcile the observed conditions. It is well known that a battery of two Daniell cells in series will effect the electrolytic decomposition of water into its constituent substances, oxygen and hydrogen. The oxygen bubbles up on the anode and the hydrogen on the cathode. The gases are capable of being collected. If the gases so collected are mixed and exploded, a certain amount of energy is liberated in the recombination. This energy must have been expended by the electrolyzing current, unless we impugn the doctrine of the conservation of energy. In order that the electrolyzing current may expend energy at the rate which the evolved gases can liberate, it can readily be shown that the voltage at electrodes must be 1.48 volts, approximately, over and above that required to satisfy the drop of potential, or IR drop, in the electrolyte considered as a simple resistance. This accounts for the crude fact that one Daniell cell will not visibly decompose acidulated water; while two Daniell cells will. Excluding temperature changes and their effects, the theory, at first glance, would seem to be thus satisfied.

But the matter is by no means so simple. It was observed many years ago that with one Daniell cell a feeble current passed through water without visible decomposition. The voltage could be brought down to a small fraction of a volt, and yet traces of an electric current might be detected in the water. Very complex phenomena of polarization were observed, varying with the voltage, the current strength, the nature of the solution, the arrangement of electrodes, and yet other conditions. One of the most intricate problems that could be cited would be a given set of conditions for a liquid voltameter under a given magnitude of impressed e.m.f. at electrodes. Roughly speaking, there would or would not be visible electrolysis, according as this e.m.f. was less or greater than 1.5 volt. But the predetermination by theory as to just how much current would be found flowing through the cell after a given time of application would baffle all computation. Not even the theoretical outline of the actions involved was known.

Prof. Richard's papers throw light on this obscure phenomenon. The theory is that if the water contained no dissolved impurities of oxygen and hydrogen, it would not conduct until the applied pressure was 1.5 volt, the amount required by thermo-chemical law. In general, however, there will be some dissolved oxygen and hydrogen. The application of, say, 1 volt to the water, or dilute sulphuric acid, establishes an electrostatic gradient through the liquid mass, under which the oxygen ions come trotting to the anode, and the hydrogen ions to the cathode. The oxygen ions are not, however, liberated, but combine with the dissolved free hydrogen atoms swimming around the anode; while the hydrogen ions similarly combine with the dissolved free oxygen atoms around the cathode. Consequently, no decomposition occurs in the solution, taken as a whole, and yet the transfer or ions and delivery of electricity to atoms has taken place in the condition that we call a feeble electric current. But this process of conduction without decomposition depends upon the initial stock of dissolved atoms. As the stock gets consumed the process of conduction tends to stop, by a building up of c.e.m.f. at the electrodes towards the magnitude of 1.5 volt necessary to effect true electrolytic decomposition. The strength of current falls lower and lower as time goes on, and the dissolved atoms get used up, until finally we may suppose that all the dissolved atoms have been consumed. This would mean eventual absolute non-conduction of the solution for pressures below 1.5 volt.

But this condition cannot be attained, because some of the ions drawn over toward the electrodes by the electric gradient drop into solution as atoms and these drift by regular diffusion to the opposite electrode. That is to say, the electrolytic movement of ions sets up a small dissolving process. Thus, some of the hydrogen ions electrolytically impelled towards the cathode go into solution as free hydrogen atoms or molecules. These cease to be electrified ions, and drift about aimlessly. By the ordinary process of diffusion they will find their way eventually to the anode. There they can act as neutralizers for freshly impelled oxygen ions, just like originally dissolved hydrogen. The final residual current through the solution may thus take many days to attain; but its magnitude will depend on the speed with which atoms starting at one electrode can diffuse to the other electrode. That is to say, the final residual current through the solution at low voltages will depend upon the shortness of the electrolytic path through the cell. A number of experimental measurements are adduced in the paper in support of this diffusion theory of residual current through water. They seem to be fairly well explained on this hypothesis. Assuming the theory to be correct, it might still be impossible to predict the strength of current produced by one volt acting on a voltameter for x minutes; but it might, at least, be possible to predict the ultimate strength of current through the cell if its geometrical form were simple enough to admit of diffusion being computed.

September Meeting of the American Institute of Electrical Engineers.

The September meeting of the American Institute of Electrical Engineers was opened last Friday evening by retiring President C. F. Scott, who, after pointing out the success of various movements in several lines, particularly in that of local branches, which are the beginnings of a great future for the Institute, introduced the president-elect, Bion J. Arnold.

President Arnold in taking the chair said that while the constitution does not call for a formal address from the incoming president at the time of his inauguration, which address is specified for the general meeting, he would follow custom and briefly point out the lines which he believes should be followed during the coming year. The remarks of Mr. Arnold are printed in another column.

Mr. George A. Henry, Jr., and Joseph Le Conte presented a paper entitled "An Efficient High-Pressure Water Power Transmission Plant," which is devoted to a description of the Pelton water wheels used in the new plant of the Edison Electric Company, of Los Angeles, Calif., and records of tests made on the wheels. In the absence of the authors the paper was read by Mr. F. O. Blackwell. The head utilized is equal to 1,960 ft. vertical fall, corresponding to an effective pressure at the wheels, allowing for friction loss, of 825 lbs. per square inch. The power of the wheels is controlled by means of a combined throat needle and deflecting nozzle. The nozzle is operated automatically by a governor, and the needle controlled by hand. Each generating unit is of 750-kw normal capacity at 430 r.p.m., with a margin for 50 per cent. of overload; the number of units and voltage is not given in the paper.

The paper describes the pipe line, water wheels and governing arrangement in detail, and gives the results of tests to determine the efficiency of the wheels for different loads and styles of nozzle tips. The experiments showed the necessity for very careful calculation to establish the more efficient shapes of needle and tip. The tests gave wheel efficiencies varying from 76.5 per cent at 482 at 331 kw to 86.8 per cent at 826 kw.

In the discussion of the paper Mr. F. O. Blackwell gave further details of the Los Angeles transmission, formerly known as the Redlands plant, and the first three-phase transmission plant in this country. The line voltage is 35,000, and there are seven power stations located up to 100 miles apart, all feeding the same transmission line. The Edison company is now developing on Kern River a new station which will have a capacity of 20,000 hp, generate at 60,000 volts and transmit to Los Angeles, 150 miles distant. The diameter of the wheel referred to in the paper is 7 ft., and that of the nozzle 2 inches, giving a ratio of 40 to 1, the usual ratios being from 5 to 10 to 1. The needle nozzle not only increases the efficiency at partial load by cutting down the water used, but increases the efficiency at the bucket, since the stream is directed at the center of the same. The original Redlands plant had an efficiency of 70 per cent. at full load, which has been increased to 85 per cent. at full load and 75 per cent at half load, while the regulation is inside of 2 per cent. The high-head part of the pipe line has forged flanges. Mr. H. A. Lardner said that the Santa Ana pipe line is of steel pipe with flanged joints bolted together with no provision for expansion, the head being 900 ft. Since the water in the case of the California plants has about the same temperature throughout the year, it is probably not necessary to provide for expansion; moreover, nearly all lines have a considerable curvature, horizontally or vertically. The Standard company has a cast-iron section for the upper third of its pipe line, each length of pipe being firmly grouted into the rock on the side of a mountain. A rivetted pipe line in Colorado has given some trouble. Some of the wheels of California plants have two sets of runners and two nozzles, the latter being both full on, or one partially on or entirely off, depending on the load. President Arnold said that in the majority of cases it is found desirable to put in a steam plant rather than rely on water power, except where the price of coal is very high.

Mr. H. A. Lardner, in the absence of the author, Mr. Augustus J. Bowie, read a paper entitled "Electric Motors for Centrifugal Pumps and Fans," in which the subject was treated under the following heads: Constant speed and varying load; changing speed with head varying directly as square of speed; constant head and varying speed. Mr. Bowie points out that a centrifugal pump, when operated at too low a head, shows a very low efficiency. In general, however, with a well-designed pump, the range of efficient operation for a constant speed is fairly broad. He emphasized the danger of overloading a motor through too low a head. A manufacturer will usually guarantee a certain efficiency and input for a pump at its rated load, but will say nothing concerning the power required to drive it at heads lower than that called for. The question may arise, why not give a pump the proper speed for a given head. This is frequently impracticable, since pumps must often be installed to work under widely varying heads, where it is not an easy matter to change the speeds. Oftentimes the heads at which the water must be elevated may vary practically from zero to the maximum head against which the pump will deliver. In some cases these overloads may be of long duration, and a sufficiently large motor should be installed. On the other hand, the maximum load will often be only of short duration, as, for example, in the case of pumping from a well, particularly where there is a pit in connection with it, which is partially filled up with water. Generally it will not take the pump long very decidedly to lower the water, and the duration of overload will be brief.

Increasing the speed of the runner, where the effective head varies as the square of the speed, will result in increasing the capacity of the pump directly as the speed, and increasing the power input and output directly as the cube of the speed. The condition presupposed in this case, namely that the head varies as the square of the speed, is the condition which exists in the case of ventilating fans.

The condition of constant head exists when pumping against a fixed lift, when the velocity heads lost at entrance and discharge, and when the fractional losses in the pipe may be disregarded in comparison with the lift.

In this case the input increases faster than the cube, and not as fast as the fourth power of the speed. Ten per cent. increase in speed represents 40 per cent increase in power and 96 per cent increase in the I^2R loss in the armature. From this it may be seen what an extremely large effect speed variation has on motors driving centrifugal apparatus. There is perhaps no other form of apparatus so sensitive to change of speed in its power consumption. The effect which a steady pump load has in holding the voltage constant by preventing the racing of generators is thus explained.

Mr. Bowie considers that speed control of direct-current motors by variation of field resistance has a limited range in practice and has many points which tend to make it objectionable for the best conditions of commutation. Even at best there will be considerable field distortion at the high speeds. The effect of a load which would increase as the cube of the speed, and even faster would seem to limit still further the allowable speed variation to be obtained in this manner. While the output of a centrifugal pump varies directly as the speed of revolution, many manufacturers rate their pumps at a fixed volumetric output, and publish a list of suitable speeds for different heads under which it may be desired to operate the pump. In some cases the highest speed given in these lists is three, or more times as great as the lowest speed. Such misinformation leads to a great deal of trouble and cannot be too strongly condemned.

The paper includes curves from tests of centrifugal fans, giving the relation between pressure, input, output and efficiency.

In introducing the discussion, President Arnold said that anyone who has attempted to vary the speed of a motor working on a pump and gotten the former working at a speed too high for the pump ought to be able to appreciate the considerations laid down in Mr. Bowie's paper. Mr. Stott said that the variation of power taken by centrifugal pumps under different heads is so complex that it seems impossible to make any equitable flat-rate for electric power for that service, and wattmeters should be installed. His experience with shunt-wound motors applied to centrifugal motors working on barometric condensers has been unfortunate; a variable speed motor is indicated for this use, since in starting, a speed at least 15 per cent. above normal is required. Mr. J. J. Brown disagreed as to this point, saying that recent developments have shown that within reasonable variations of head, such as 10 to 20 per cent., constant-speed motors can be used on barometric condensers without serious overload. Mr. F. O. Blackwell said that the very high head centrifugal pumps with several sets of runners, each one feeding into the next one, is a development extremely promising, and in time he believes it will replace the reciprocating pump altogether for all heads. These pumps are being made with each runner up to 100 ft. head, and there have been as many as seven or eight sets of runners connected together, which would give 700 or 800 ft. total lift in the pump, and the efficiencies have been very high, too. Eighty per cent. efficiency has been obtained with these high head plants with the centrifugal pump, which is practically as good as given by any reciprocating pump.

Mr. Ralph L. Montague contributed a paper entitled "A Suggested Hydraulic Unit," which is reprinted elsewhere in full.

Electrical Supply in Fitchburg.

FITCHBURG, Massachusetts, in the upper valley of the Nashua River, varying in parts between 500 and 900 feet above tide water, and fifty miles by rail from Boston, is a center of industry. The machine tools, the textile fabrics, the power machinery and the paper manufactured in this city are widely and favorably known.

With a population of 31,531 by the late census, the city enjoys a pure water supply, a large public library, a park that would add charm to any municipality, a hospital that is probably unexcelled within the Commonwealth as to location and equipment, a new Federal building and a large number of attractive retail stores. As may easily be guessed from these facts, the prosperity of Fitchburg rests not on a location close to some great commercial center, but rather on the enterprise of its business leaders and the industry of its population.

Such conditions favor the development of an electrical supply system, and the physical location of the city has had a like effect. The Nashua River, whose head waters trickle down from the 2,015-ft. summit of Mount Wachusett some eight miles distant, marks the line along which the industrial and commercial interests of the city are closely grouped. On the abrupt hills which rise a little way back from the river bed on either side are the handsome residences of the mill owners, and the more humble but substantial homes of the operatives.

The city thus offers an attractive distribution area, since all of the heavier electric loads are comparatively close to a generating station at any point near the river bank, and even the residence lighting is not far away. Under these circumstances an electrical supply system has been built up, and the new plant recently completed to furnish energy for this system, while of only moderate capacity, equals the best to be found elsewhere in construction and equipment.

Public electrical supply seems to have been inaugurated at Fitchburg by the Wachusett Electric Light Company, a Maine corporation organized in 1883. The date on which this company began to do lighting in Fitchburg is not at hand, but the start was probably several years after its organization for the dynamo capacity of its plant had reached only 150 arc lamps of 1,200 nominal candle-power each, and 500 incandescent lamps of 16 nominal candle-power, in 1889. During the year just named the Fitchburg Gas Company secured authority to engage in electrical supply there, and shortly thereafter this company purchased the Wachusett plant.

In December, 1895, the name of the Fitchburg Gas Company was changed to Fitchburg Gas and Electric Light Company, and the present corporate owner of the entire gas and electric supply systems of Fitchburg was born. On June 30, 1902, the connected electric load of the Fitchburg Gas and Electric Light Company included 89 commercial arc lamps of about 1,200 candle-power each, 300 public arcs of like rating, 12,750 commercial incandescent lamps, and 40 direct-current motors of 217 horse-power total capacity, on a 500-volt circuit. This lighting load was carried on direct-current series arc circuits, and 60 cycle alternating circuits of about 2,300 volts. Wires in these circuits had a total length of 68,700 feet, all overhead, and was carried on 1,488 poles, of which 1,460 were set in 168,000 feet of public streets.

The generating station for this system was located not far from the Nashua River, and close to the union station and railway tracks, at the east end of the main business section of the city. Like so many other sections of the older type, this plant contained fire-tube boilers, slow-speed horizontal engines and belted dynamos. On June 30, 1902, the equipment consisted of five boilers with a total rating of 550 horse-power, four engines rated at 450 horse-power, and seven dynamos with a combined capacity of 370 arc lamps or 1,200 candle-power each and 4,000 incandescent lamps of 16 candle-power; also two

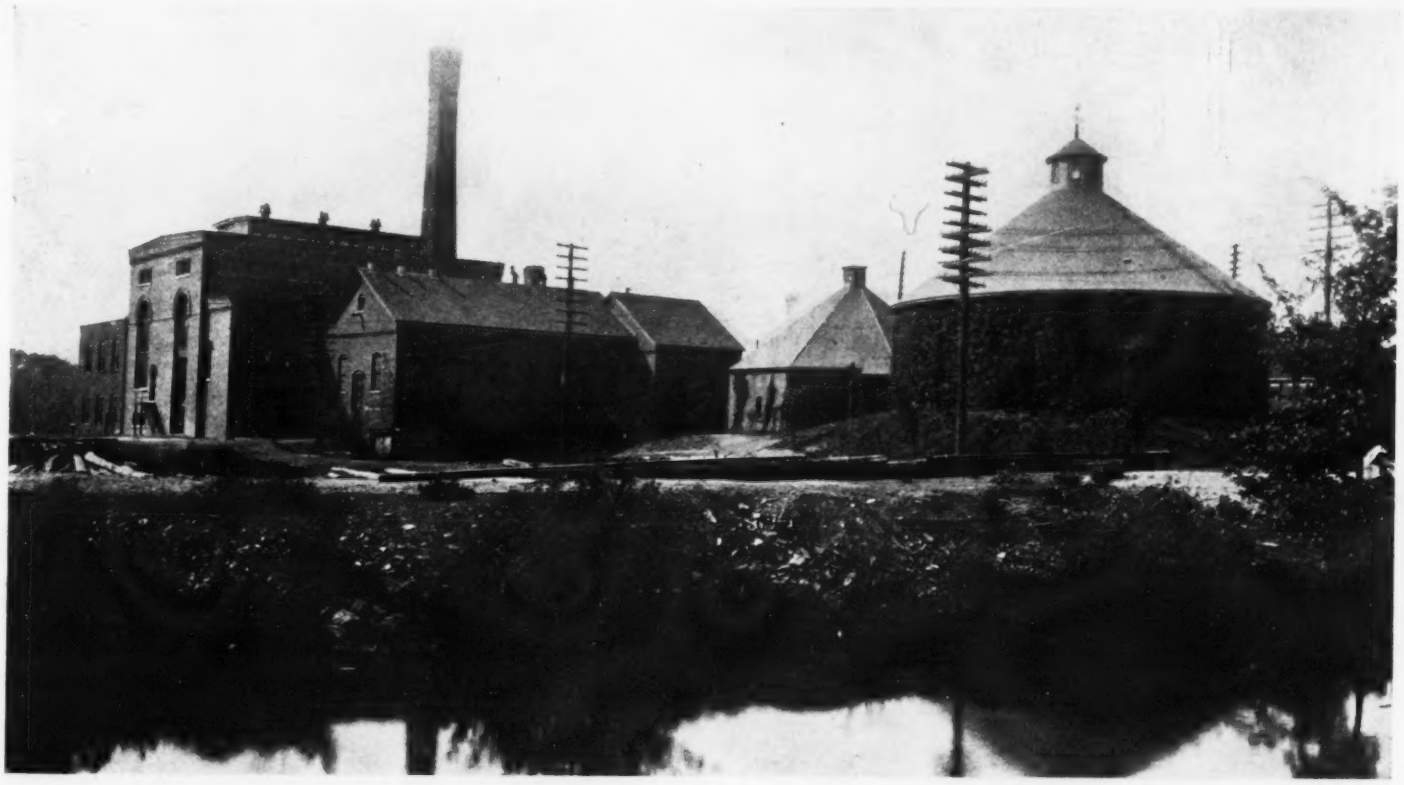


FIG. 1.—NEW AND OLD STATIONS AT FITCHBURG.

500-volt power generators with a total rating of 155 kilowatts. With these classes of equipment, and arc and incandescent lamps and motors each operated by separate dynamos, a very high efficiency was not to be expected, but the income from sales of electrical energy per ton of coal burned at the Fitchburg plant has been held at a creditable figure, considering the circumstances, through a series of years, as pointed out in the paper on efficiencies of electric stations in the ELECTRICAL WORLD AND ENGINEER of September 5, 1903. For each of the years ending June 30, between 1892 and 1902, both inclusive, the electric income of the Fitchburg Gas and Electric Company per ton of coal burned at the generating plant was as follows:

Year	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.
Dollars	26.93	24.99	31.00	25.14	23.68	24.17	25.34	28.46	29.81

Prior to June, 1902, the capital stock of the company was $150,000, and its prosperity was such that no bonds had ever been issued. In that month a further issue of capital stock to the par value of $150,000 was decided on in order to build and equip a new generating station. Stockholders were given the first opportunity of subscription to these new shares at an advance of 20 per cent. over their par value.

The new station of the company adjoins the site of the old one,

and represents the most modern ideas in fire-proof construction and power plant design. The main building, containing the engines, generators, transformers and switchboard is 56 by 90 ft. in plan, outside, is 38 ft. Outside, the building stands 53 ft. 9 in. from the top of the foundation to the eaves.

The roof is of tar and gravel laid on plank, which is supported

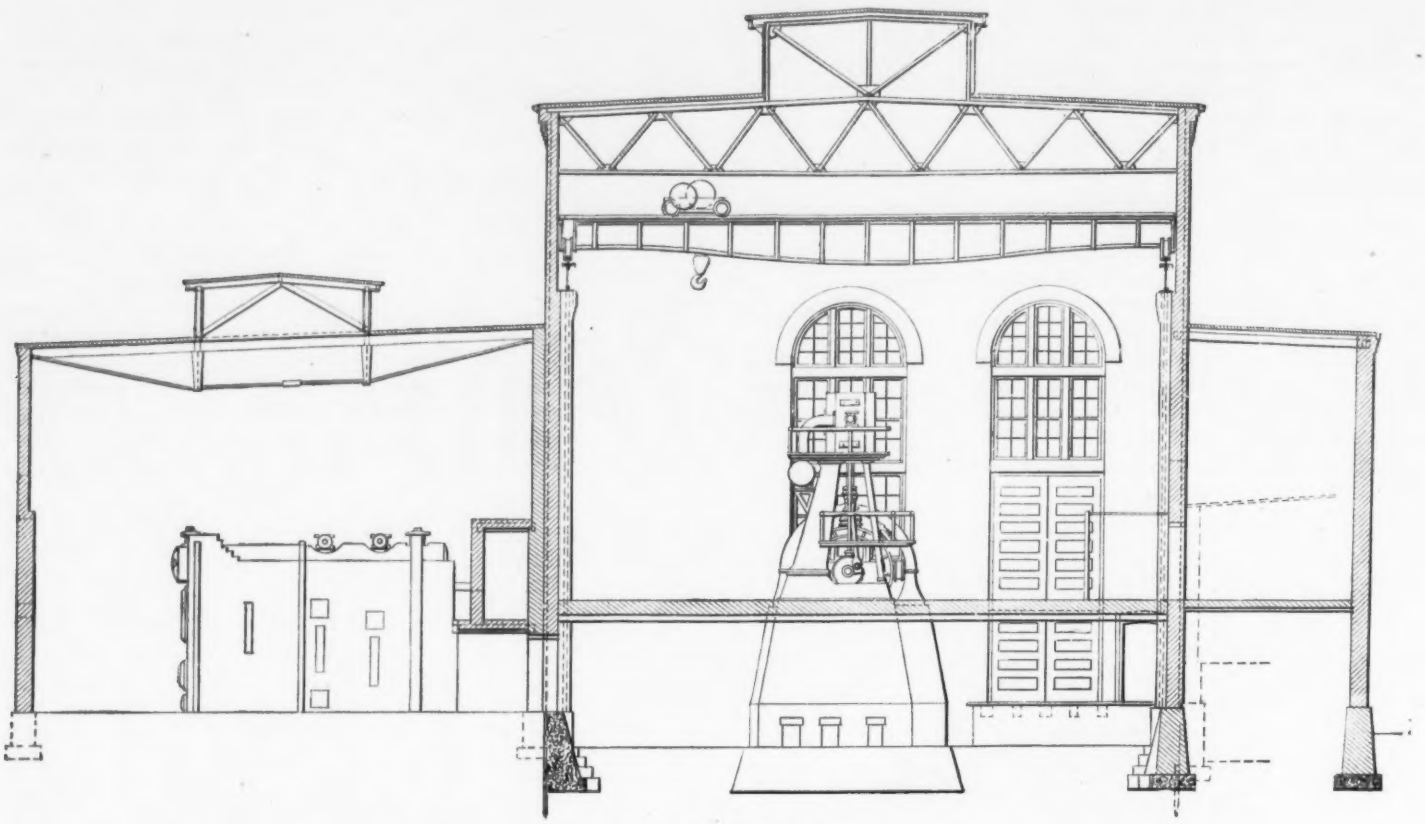


FIG. 2.—CROSS SECTION OF STATION.

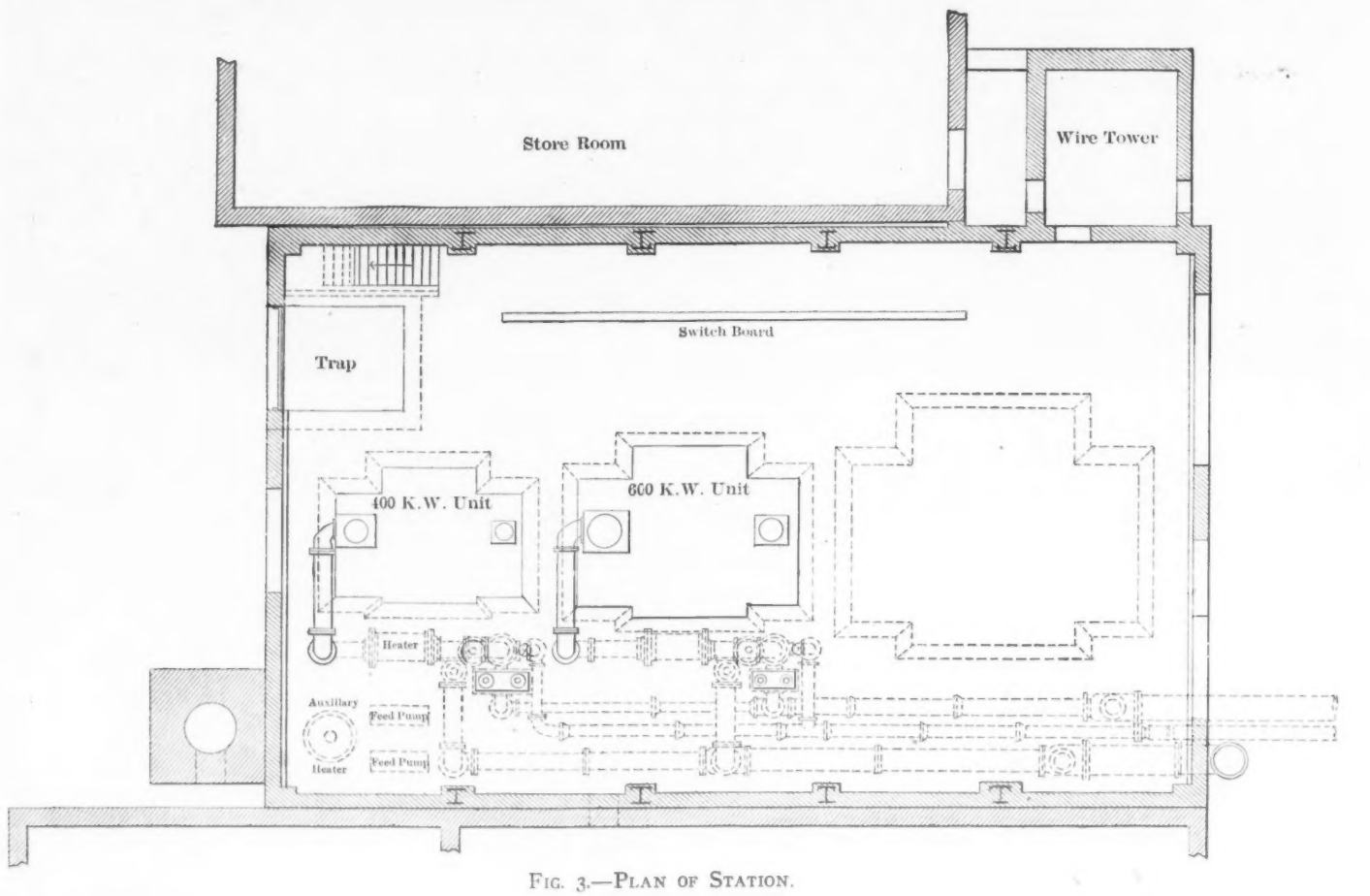


FIG. 3.—PLAN OF STATION.

and contains a basement and first floor room. Between basement floor and the main or engine room floor the elevation is 13 ft., and from engine room floor to the lower cord of the steel roof trusses by the steel roof trusses. Along the center of the roof in the direction of its greater length runs a monitor with side windows for ventilation. Between the inside of the monitor roof and the floor of

the engine room the distance is 52 ft. In structure this building is steel and brick with concrete foundations and floors. The concrete foundations have a depth of 10 ft. below the brick walls. The brick walls are 16 in. thick to a distance of 27 ft. 3 in. above the floor level. At that elevation the two opposite walls on the longer sides of the station shrink to a thickness of 12 in. each. In the corners and at intervals of 17.5 ft. on each of the longer sides brick piers increase the thickness of the wall to 28 in., and in each of these piers, save those at the corners, there is set a steel column. On the shelf formed by the change in the thickness of the walls, and by the tops of the brick piers and steel columns, rests the steel tramway over which moves a crane that sweeps the length and breadth of the room.

For its main floor the station has cement covered with sheets of cork, and supported on steel beams. The basement floor is solid concrete. A dado to a distance of five feet above the main floor runs about the four walls inside, and above this the walls are finished with enameled bricks. The engine and generator room is lighted by eight large windows below the crane level, 42 small windows higher up in the walls, and 24 windows in the monitor.

At one corner of the main building, and outside of the dimensions already named, a brick wire tower 14 ft. 8 in. by 12 ft. 6 in. on the ground rises to a height of 36 ft. Close to one side of the main station is a brick store house, and on the opposite side is the boiler

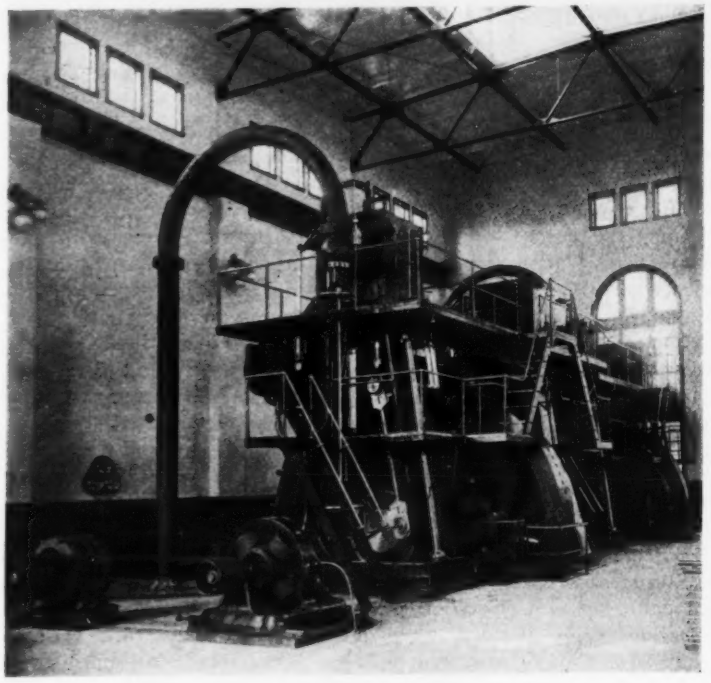


FIG. 4.—MAIN GENERATORS.

house, also a separate building. This boiler house, when completed, will have brick walls, a cement floor and a tar and gravel roof, this last supported by combined iron and timber trusses. On the ground the dimensions of the boiler house will be 43 ft. by 69 ft. 10 in., inside, and the height from the concrete floor to the lowest points of the roof timbers will be 31 ft. A monitor with windows will run along the center of the boiler-house roof.

At one end of the boiler house and separated from it by a 16-in. brick wall is a room 42.5 ft. square for coal bunkers. The brick chimney 11 ft. square on the ground and with a 5-ft. circular flue is located at one corner of, but entirely without, the walls of the main station.

Space is provided in the boiler house for water-tube boilers of 1,250 horse power total capacity, and three Sterling boilers of 250 horse-power each will be installed at the start. These new boilers will operate at 150 pounds gauge pressure. Meantime, the old boilers are in use.

Steam mains from the boilers enter the basement of the generating station, and rise thence to the engines. In this basement are located the two Warren condensers, the two feed pumps, a heater for each engine, an auxiliary heater, and all the pipes and valves necessary to connect this steam apparatus.

On the main floor of the station space has been provided for three generating sets of different capacities, and the two smaller sets have been installed and are in regular operation. Each of these sets consists of a vertical, cross-compound engine with a direct-connected generator mounted between the high and low-pressure cylinders. The smaller of these two engines has cylinders of 18 and 36 in. diameter, respectively, with a 36-in. stroke, and is rated at 650 horse-power with 150 pounds steam pressure and 120 revolutions per minute. This engine sets with its connected generator on a masonry foundation that is 21 by 22 feet square at its base, tapering to 18 ft. by 19 ft. 3 in. at the top, and 23 ft. high. Of this height 10 ft. is underground and 13 ft. extends from the basement floor to that of the

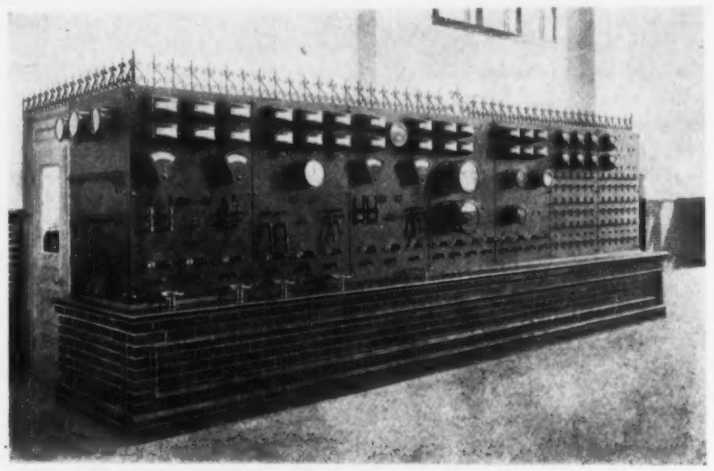


FIG. 5.—NEW SWITCHBOARD.

engine room. Direct connected to this engine is a three-phase, 60 cycle, 2,300-volt alternator of the internal revolving-magnet type, and with a capacity of 400 kilowatts.

The engine of the larger generating set has cylinders of 22 and 44 in. diameter, respectively, with a 36-in. stroke, and like the smaller engine, operates at 120 revolutions per minute. With 150 pounds steam pressure this engine is rated to develop 1,000 hp. Beneath this large unit the foundation sinks to a depth of 23 ft., 10 ft. of

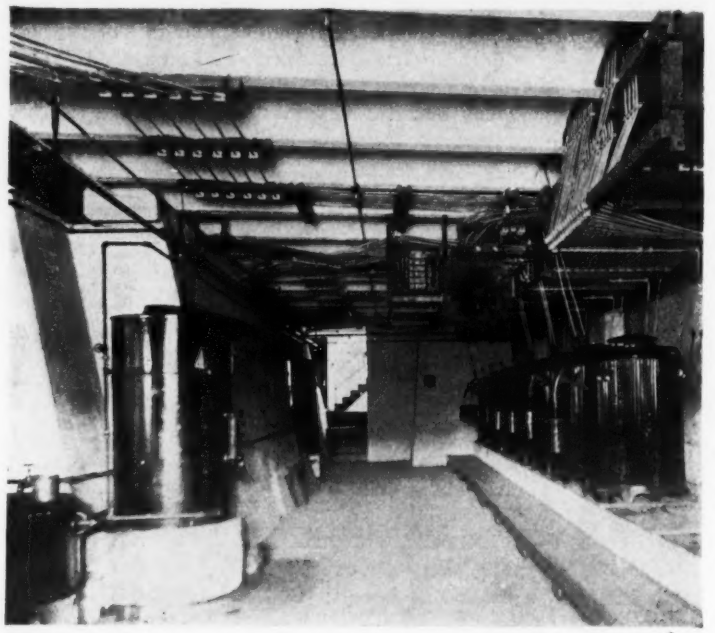


FIG. 6.—TUB TRANSFORMERS IN BASEMENT.

which is below the basement floor. At its base this foundation measures 24 ft. 9 in. by 23 ft., and tapers to 21 ft. 9 in. by 20 ft. at the top. The generator connected to this larger engine is three-phase, 60 cycle, 2,300-volt, and is rated at 600 kilowatts. Both of these engines were built by McIntosh and Seymour. The two alternators are of the same type, and were built by the General Electric Company. With these two generators the station has a capacity of 1,000 kilowatts, and this may be raised to 2,000 kilowatts by the addition of a third engine and generator in the vacant space. Oil is supplied to the generating sets automatically from pumps and tanks

in the basement. Each engine governor is electrically controlled from the switchboard, so that the two units can easily be brought to uniform speed for parallel operation.

Current for the revolving magnets of the main generators is supplied by either of two exciters, one rated at 30 and the other at 35 kilowatts. The smaller of these exciters is driven by a direct-connected, vertical engine, and the larger is coupled to an induction motor. Both the exciters and their engine and motor are of General Electric make. The only belted apparatus about the new station is an induction motor driving a 500-volt, direct-current generator of small capacity, which latter carries a part of the stationary motor load. This direct-current set will be removed when all connected motors have been changed to the alternating type.

About midway along one side of the generator room the switchboard is located with its back 7 ft. from the brick wall. The board is made up of nine panels of black Monson slate mounted on a base of enameled brick. A door at either end of the switchboard gives easy access to the large space behind it, where all connections are accessible. Of the nine panels in this board, one controls the station lamp, one is devoted to meters and ground detectors, two panels are fitted for series arc circuits of 600 lamps total capacity, one panel handles the 550-volt, three-phase motor circuits, another the 2,300-volt lines for commercial arc and incandescent lighting, and three panels connect the generators. All the main switches connected with the switchboard are electrically operated, and lamps on its face indicate whether each switch is closed or open.

The differences in generating apparatus at the old and new stations have brought with them changes in the connected loads. It is, of course, desirable to carry all of the loads on the two main alternators. This is done in the case of the motor load by a substitution of 550-volt, three-phase, induction motors for a part of the direct-current machines formerly in use, and by the motor-driven generator already named at the station for the remainder of the direct-current motors. In the case of the direct-current, open-arc street lamps the change has been even more complete, as all of these lamps have been replaced by alternating, enclosed arcs. The old direct-current lamps were of the double carbon type, and rated at 1,200 candle-power, or about 300 watts each. At the terminals of each of the alternating enclosed arcs from 430 to 450 watts are required. It is expected that the change from open to enclosed arcs will greatly improve the street-lighting service, as much trouble has been experienced in the past with open arcs in ice storms and high winds. During December last the number of arc street lamps reported out for the month was 207, and this was due almost entirely to bad weather.

To operate the present load of about 300 arc street lamps and also provide some reserve capacity, eight constant-current or tub transformers have been installed in the basement at the main station, underneath the switchboard. Each of these transformers has a capacity of fifty enclosed arc lamps, rated at 450 watts each, or about 22,500 watts total. These constant-current transformers each change the 2,300-volt pressure of the main generators to about 4,000 volts as a maximum on an arc line. All of the commercial arc and incandescent lighting is carried by the 2,300-volt, three-phase, 60-cycle circuits.

The new station and equipment above outlined embody the ideas of Mr. H. F. Coggshall, general manager, and of Mr. A. H. Kimball, electrical superintendent of the company, as well as those of the architects, Sheaff & Jaastad, of Boston. S. S. Lawrence & Son were the contractors for the station. The switchboard was built by S. B. Condit, Jr., & Company, of Boston.

This new generating plant is not the only public utility that the enterprise and public spirit of General Manager Coggshall has given to Fitchburg. Coggshall Park lies on the slopes of Mount Elam, which rises to an elevation of 840 ft. at one side of the city. This park is approximately 0.4 mile long and 0.25 mile in maximum width, and is the free gift of Mr. Coggshall to the citizens of Fitchburg. Probably no municipal park in the Commonwealth, aside from the Metropolitan system about Boston, rivals this one at Fitchburg in natural beauty and advantages.

Electrical Transmission for Chicago.

A dispatch from Chicago says the Sanitary Board of that city proposes to construct a water plant in Lockport township, utilizing the flow in the Chicago drainage canal. The electrical power thus generated will be transmitted to Chicago and other places.

Electrical Progress in Egypt.

By Henry L. Geissel.

ELECTRICITY is penetrating more and more every quarter of the globe. Wherever conditions are favorable, the electric current is generated by water power and takes the place of steam. That this should be especially the case in countries poor in coal is but a matter of course, and whenever those countries, on the other hand, are privileged with an abundant presence of powerful waterfalls, the installation of electric power stations is assuming larger proportions all the time.

The writer visited last year a number of countries bordering the Mediterranean. He was surprised to find that the application of electricity, both for power and for lighting purposes, had made immense progress in Spain and Italy, and even on the Italian islands of the Mediterranean. However, this is but natural. Most of the countries in Southern Europe do not produce any quantities of coal worth mentioning, while they have at the same time wonderful hydraulic forces, and there is little doubt that these very same territories will offer in the near future a most valuable field for the sale of our surplus manufactures of all kinds of electrical machinery and appliances. But not only in countries which offer special opportunities for the introduction of electric power, but also in those which produce no coal, and are destitute of natural water power, electricity is making steady progress.

This is especially the case in the land of the Nile, where electricity has doubtless made better headway than in many European countries. Egypt may be regarded by the majority of American manufacturers and merchants as a market of little or no importance, but their attention may be drawn to the steadily and largely-increasing imports to prove it a field well deserving of their close study. With the opening up of the Dongola province, the imports in many lines of manufactured goods will go ahead with great strides, and there is plenty of chance for American firms to extend their operations to Egypt, provided they are prepared to do so in an enterprising spirit.

Comparing the population of Egypt with some other countries, it may be of interest to mention that it has about three times that of the whole of Central America, and in South America, Brazil is the only country which exceeds Egypt in population. American engineering enjoys the very best reputation in Egypt. The building of the Atbara bridge by American engineers, the supply of American locomotives for the Egyptian railways, and the considerable imports of agricultural machinery from the United States have largely contributed to this reputation.

Strange, therefore, that our electrical business, which a few years ago obtained some foothold on the Egyptian market, is now decreasing, while that of other nations is growing. The German consul-general at Cairo prepared recently an exhaustive, and, it may be added, highly interesting report on the present state of electricity in Egypt, and the following abstract from this official document will doubtless prove of interest to readers of the Electrical World and Engineer.

The physical conditions of Egypt, says the German official, do not in any way present special inducements for an extensive application of electricity, as the country does not possess any amount of hydraulic power which could be utilized. To generate current Egypt has to-day to avail herself of steam engines or other prime-movers. In spite of this great drawback, electric light has not only penetrated such cities as Cairo and Alexandria, but has also made its appearance in the larger towns of the interior, such as Mansurah (34,000 inhabitants); Jantah (57,000); Zifta (14,000); Suez (25,000); Heluan (3,000), and Ismailia (7,000). Electric light is also about to be installed at Assiut (119,000 inhabitants); Fayoum (31,000); Yagaziz (32,000), and Demanhur (32,000).

In Cairo the Gas Company, by a contract entered into with the government in 1897, secured the exclusive right to supply electric light for a period of thirty years. The plant of this company is equipped with six steam engines of a total capacity of 12,000 hp, driving six dynamos of an average capacity of 800 kw. In 1901 there were 1,230 customers using 7,000 lamps, an increase of 36 per cent. over the previous year. The underground cables had a length of 72,000 meters, and the current was supplied at the rate of 1 franc (20 cents) per kw-hour. At the expiration of the contract the entire system becomes government property. There are, besides, a number of private installations at Cairo, but all of them are of relatively little importance. Thus, for instance, the National Printing Office

has a small plant which derives its power from a small 20-hp steam engine, generating current for light as well as for working the presses. Another little installation supplies light for the Abassije Hospital, situated in the suburbs of the city. The Vice-Royal Opera House possesses a plant with two dynamos feeding 850 incandescent lamps and six arc lights. Two of the larger hotels have also their own electric plant. As to private industrial enterprises outside of the city of Cairo, no statistical returns are available.

In the city of Alexandria it is also the local Gas Company which supplies the electric light. But there the plant is owned by the municipality, and is in no way dependent upon the government. Neither Cairo nor Alexandria has a street lighting system. In this regard the two largest cities of Egypt are far behind some of the towns in the interior, where not only historic monuments, but also the streets and squares, are lighted by incandescent lamps. At Mansurah, Suez and Heluan English companies operate the electric plants, while at Ismailia a syndicate, chiefly composed of Swiss capitalists, furnish electricity to the town. The central power station at Mansurah feeds 373 lamps installed in public streets and about the same number of lamps for private individuals. In the streets of Heluan there are 200 lanterns, each of them provided with two incandescent lamps of 26 cp. The plant at Heluan has been built in such a way as to be able to meet emergency demands, and during the winter season the plant also supplies three large hotels.

According to information furnished by the government authorities there will be built, for the towns of Jantah and Zifta, but one plant, at some place between the two cities; and this installation has, at the same time, to supply electric energy along the canal for the working of pumps and similar purposes. This plant is to generate tri-phase current at 10,000 volts, which, reduced by means of transformers, will be the first installation to transmit current over long distances ever constructed in the land of the Pyramids. For its lighting purposes the government is to pay $10 at Mansurah, $11 at Heluan, and $17.50 for the Jantah-Zifta system, per lamp per year.

Regarding motive power for industrial enterprises, it may be said that in this respect electricity has made relatively little headway so far in Egypt. As traction power, however, it is especially used on the tramways of Cairo and Alexandria, at the usual pressure of from 500 to 550 volts. The power station of the Cairo tramways, which, by the way, belongs to a Belgian company, is equipped with four steam engines, each of from 350 to 400 hp, and each of them coupled to dynamos of 200 kw. The length of the system, at the end of the year 1901, was 36 km, of which 21 km were double-track. During the same year the rolling stock consisted of 94 motor cars and 59 trailer cars. In 1900 these tramways carried 11,225,000 passengers, and in the following year 14,750,000, a daily average of 30,000 passengers for 1900, or 5.45 per cent. of the population of that year, as compared with a daily average of 40,000 passengers in 1901, or 7.07 per cent. of the population. In 1896 a concession was granted to this company for a period of 50 years, thus expiring in 1946, when the entire system, including rolling stock, becomes government property. The Cairo tramways are capitalized at 6,000,000 francs; in 1900 the gross receipts amounted to 1,500,000 francs and rose to nearly 2,000,000 francs in 1901, while the total expenses did not exceed 52 per cent. of these gross earnings. The gross receipts, per car-kilometer, were 0.65 and .054 franc respectively in 1900 and 1901.

The Cairo Gas Company employs for lighting purposes exclusively single-phase alternating current, which is not adapted to run powerful motors. During the hot season, however, this current is extensively used for driving a great number of electrical fans. As far as large storage batteries are concerned, there were only six of them in Cairo at the end of 1901.

The above remarks show evidently that Egypt offers a favorable market for a large number of dynamos, especially for those of small and medium capacity, and furthermore for the sale of suitable motors. The chances for the sale of storage batteries are smaller. On the other hand, however, all kinds of supplies for electric lighting should find a ready sale. Up to some time ago, the dynamos used in Egypt were almost exclusively of English or Swiss origin, but the Cairo Tramways Company introduced American dynamos. It seems, however, that up to the present time German manufacturers still get the bulk of the trade. In steam engines the famous Sulzer Works, of Winterthur, Switzerland, are doing the largest amount of business. The writer saw Sulzer and Tosi (Legnano, Italy) steam engines all over Southern Europe last year. These two firms are doing an immense amount of business in the countries of the Mediterranean, and it must be admitted that their makes rank among the best in the world. In petroleum motors German and English manufacturers compete together, while in gas motors Germany still holds her own. On account of the high prices charged by the Cairo Gas Company, the chances for an increased sale of gas motors are not very great at present.

Lighting fixtures are largely imported from Germany. The latter country is making the most strenuous efforts to obtain a firm foothold on the Egyptian market, and two of the leading German electrical companies are already established in the country. There is little doubt that others will follow. It was only recently that the Allgemeine Elektricitäts Gesellschaft, of Berlin, secured an important order from the Egyptian Telephone Company, the headquarters of which are at London. The order in question consisted of the laying of an underground telephone line between Cairo and Alexandria, and amounted to about $260,000. At the same time, in many quarters of Cairo, the overhead telephone lines had to be converted into underground lines, on account of grave disturbances having occurred after the completion of the Cairo-Alexandria underground telephone system. For this purpose armored steel cables, containing 100 double wires each, were employed. At the present time the Cairo underground telephone cables have a total length of a little over 20 km.

Another German firm, the Siemens & Halske Company, installed the necessary electrical equipments for the great Assuan dam, and also secured the order for the installation of an electric lighting plant at the Khartum barracks.

According to the official returns of the Egyptian custom house authorities, the imports of electrical appliances into Egypt amounted in value to $249,645 in 1899, $191,695 in 1900 and to $209,255 in 1901. In reality, however, the imports have been larger, as many machines being practically for electrical purposes are classified among other items. The official figures referred to above divide the imports of electrical appliances as follows:

	1899.	1900.	1901.
Germany	$64,735	$77,400	$115,495
Austria-Hungary	82,150	54,920	34,385
France	29,630	16,090	13,110
England	28,955	19,140	21,560
Italy	4,110	10,880	9,520
Sweden	945	1,635	11,040
United States	29,490	2,680	335

It will be seen from these figures that, while the imports from Germany and Sweden have considerably increased, those from other countries, and particularly from the United States, have largely decreased. The increase in the imports from Sweden is due to the fact that the telephone company of Cairo uses at present almost exclusively Swedish apparatus of the Ericsson make.

Recent Electrochemical Developments.

Last week but two electrochemical patents were issued, one being granted to Mr. J. W. Madigin, of Toronto, Canada, for mechanical details of construction of a non-corrosible terminal connection for storage batteries. The other patent, for a method of making bleaching liquor, was granted to Mr. Marcus Ruthenburg, well known to the public by his electric iron process. While in the manufacture of caustic alkali and bleaching powder, the anodic and cathodic products of the electrolysis of sodium chloride must be kept separate and prevented from mixing with each other, the opposite is true for the production of bleaching liquor or hypochlorites. Here it is necessary to enable the anodic and cathodic products of the electrolysis of sodium chloride to mix thoroughly to obtain the reaction resulting in the formation of hypochlorite. Any chlorine which is set free at the anode and escapes as gas is lost for the formation of bleaching liquor. Mr. Ruthenburg, therefore, does not use simply sodium chloride, but mixes it with hydrated oxide of calcium, the object being to have the chlorine taken up by the hydrated oxide of calcium, "forming additional soluble chlorine salt in the solution and thus augmenting the bleaching capacity of the latter." Another advantage is that this addition reduces the electric resistance of the cell. A mixture of 20 per cent. sodium chloride with 10 per cent. of hydrated oxide of calcium is recommended with a current density of ½ amp. per sq. in. of electrode surface, the e.m.f. at the terminals of the cell being about 3 volts.

Alternating Current Switchboards—II.

By Stephen Q. Hayes.

THE switchboards, such as are shown in Fig. 4, are mechanically the same as the 110-250-volt type previously described, but being intended for 1100-2200-volt service, the knife-blade switches of the latter are replaced by plunger switches so arranged that no charged metal parts are exposed on the front of the board.

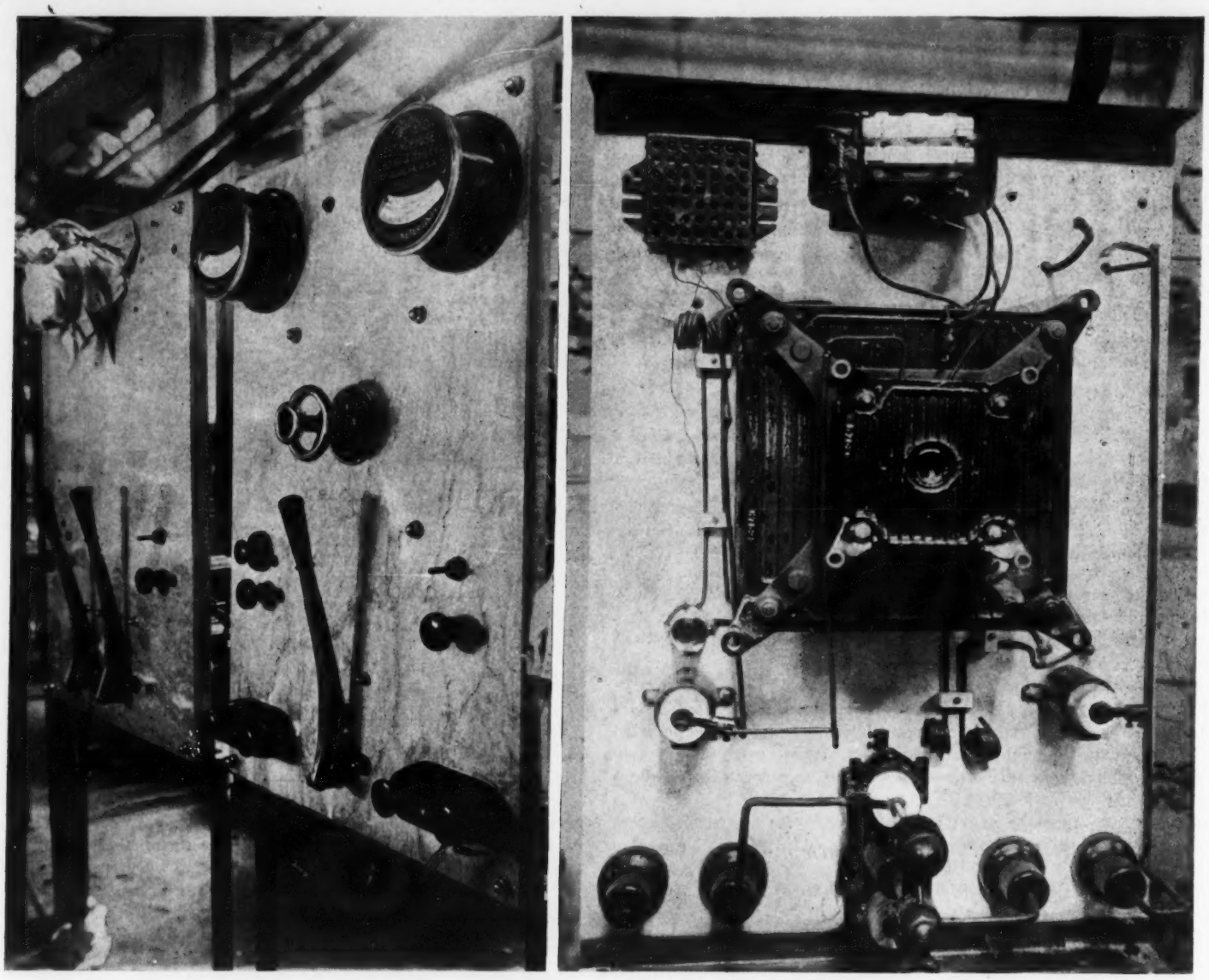
These switches consist of a cast-iron frame mounted on the back of the switchboard and serving as a support for the porcelain cylinders and as a guide for the operating rod which passes through the frame and is controlled by the handle in front. One switch terminal is mounted at each end of the porcelain cylinder, which has a ½-in. bore through which a copper rod or plunger passes, making the electrical connection between terminals.

The plungers are supported by an iron cross-head rigidly secured to the operating rod and moving with it, but entirely insulated from it. The only charged metal on the switch consist of the plungers and the two terminals on each porcelain cylinder. In opening the switch the plunger is withdrawn from the lower contact, and the arc which tends to follow it is destroyed by the combined effect of the cooling action of the porcelain walls and the draft caused by the expansion of the heated air through the outlet from the porcelain tube.

The switches used on these boards have one porcelain cylinder in each leg of the circuit, giving two breaks in series, and are known as single-brake. Switches have two porcelain cylinders in each leg, giving four breaks in series, are designated "double-break switches." The relative breaking capacity of these switches will be given later in connection with other boards.

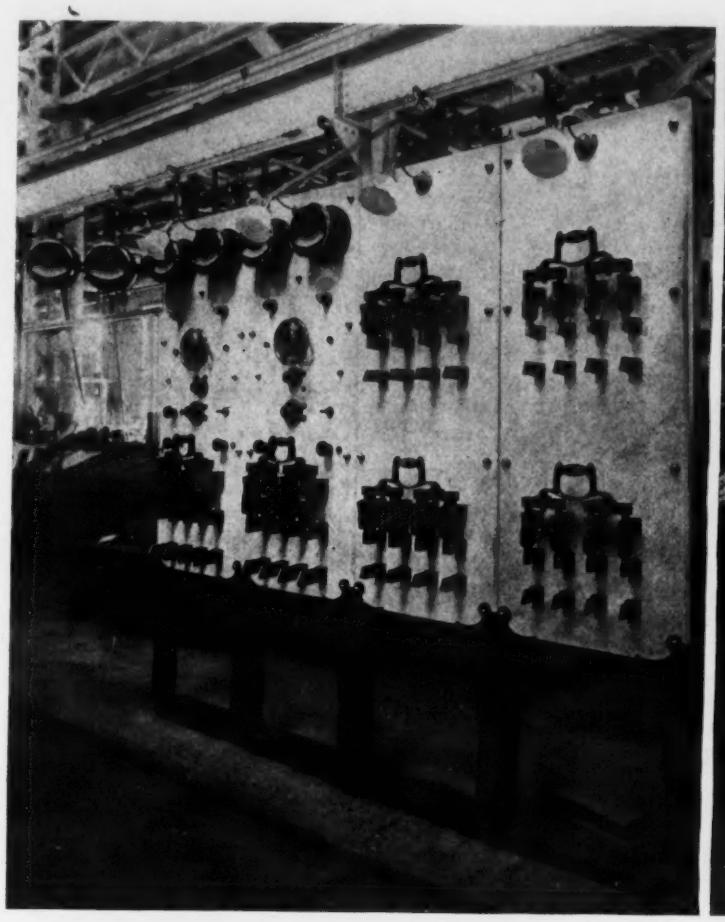
Fig. 5 is a rear view of this type of board, and shows clearly the back of the plunger switches, rheostats, fuse block, etc., used in the rear of Fig. 4. Concentric rheostats are also used on these panels, and the voltmeter is utilized, in connection with a plug receptacle and push button, for a ground detector. Under normal conditions, when the reading of the voltmeter alone is required, the plug is inserted in the two receptacle sockets that are covered by the red fibre rings.

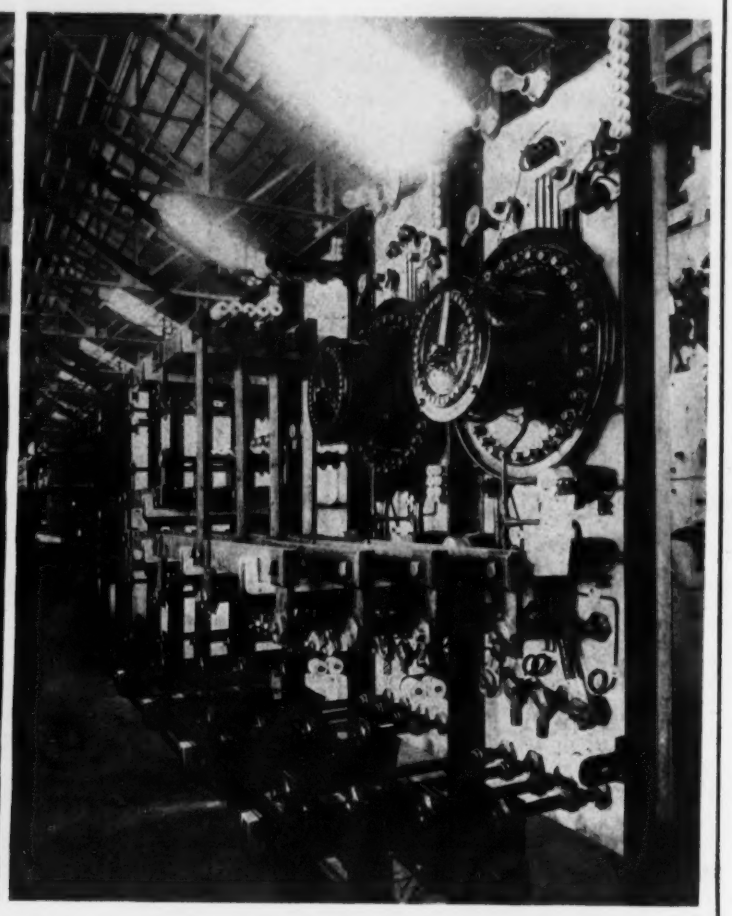
It may seem strange to some that while it is customary to recommend against the use of fuses in generator circuits, with this type generator panels with fuses are standard. The reason for this is that, as a rule, these panels are used for both generator and feeder, and the fuse is put in for the protection of the feeder circuit. While this panel can be used with multiple running machines, not more than 10 per cent. of the boards of this type are so used. When they are intended to operate in multiple, the feeders are often taken direct from the bus-bars without either switches or fuses—full dependence being placed on those on the generator panels. Occasionally the fuses on the generator panels are connected in the feeder circuits.



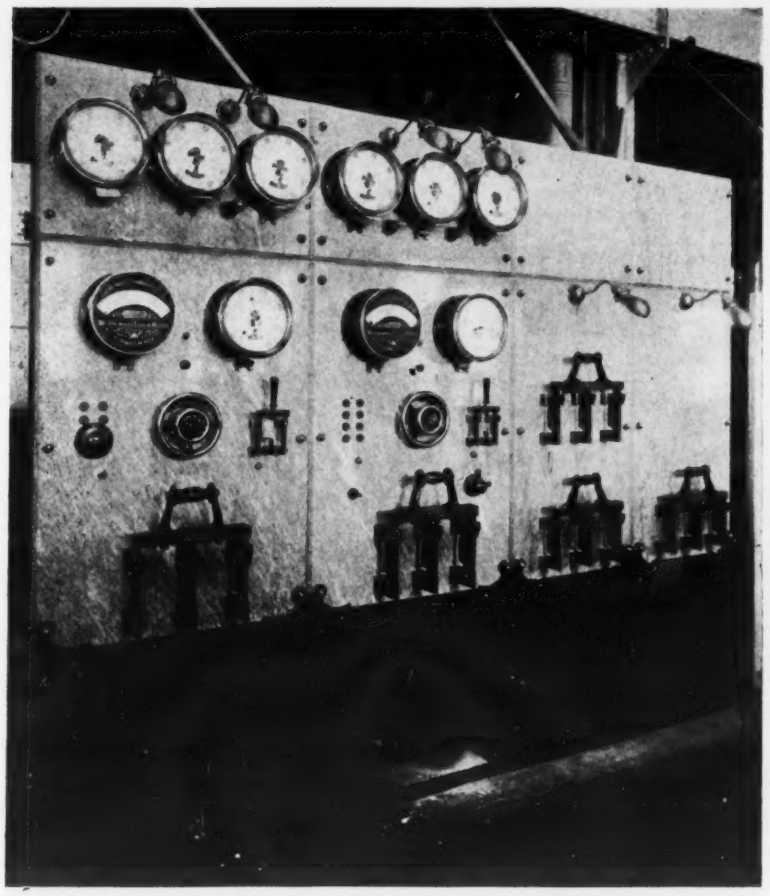
FIGS. 4 AND 5.—FRONT AND REAR VIEWS OF 1100—2200-VOLT SWITCHBOARD.

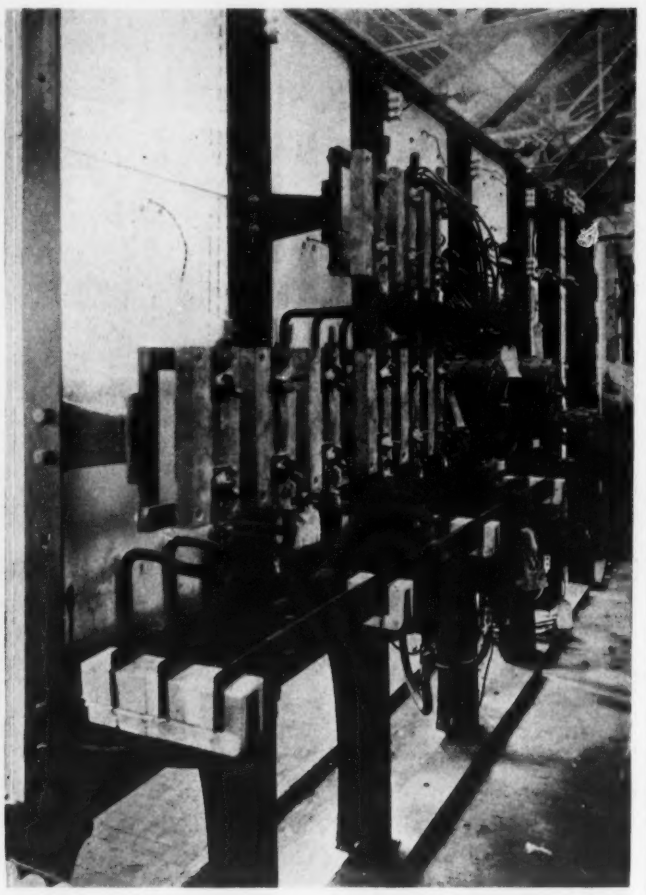
If the capacity of the panel be over 30 amp., single-pole lignum vitæ fuse blocks, described at some length farther on, are used mounted on the front of the board. If the capacity is less than 30 amp., double-pole porcelain fuse blocks are supplied, mounted on the rear of the board. The panels are built to control one generator and one feeder, single-phase, for use with a similar panel to control separately two generators and two feeders, single-phase; to control one single or one two-phase generator and two single-phase feeders; to control one generator and one feed, two-phase; to control four single-phase feeders or two single-phase feeders with dynamo changing switches; to control two two-phase feeders; to control





FIGS. 6 AND 7.—FRONT AND REAR VIEWS OF 220-VOLT SWITCHBOARD.





FIGS. 8 AND 9.—FRONT AND REAR VIEWS OF 440-VOLT SWITCHBOARD.

one generator and one feeder, three-phase; to control two three-phase feeders.

Fig. 10 is a diagram of connection for a board of this sort, and illustrates the method of operating ground detector, voltmeter and synchronizer connections. When the alternating-current generators are composite wound, additional field plugs are provided for putting these composite fields in multiple. The field plugs on boards for

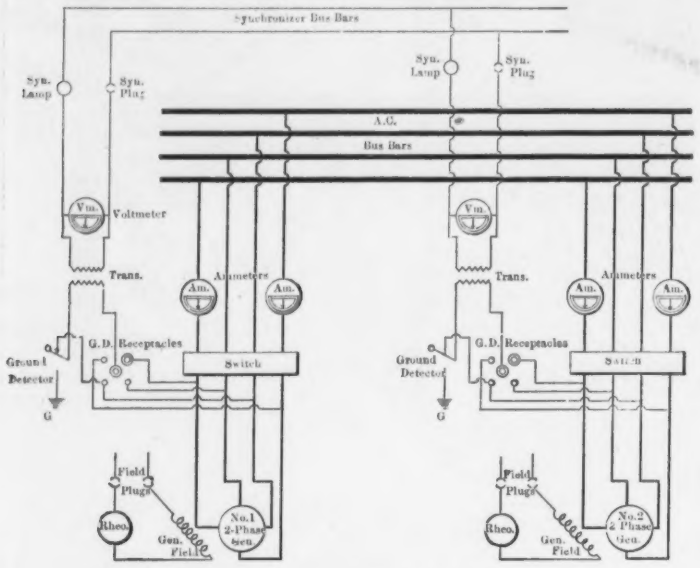


FIG. 10.—DIAGRAM OF CONNECTIONS OF 2200-VOLT BOARD.

two generators and two exciters are often so arranged that either generator can be fed from either or both exciters, or both generators from one exciter.

Next in order are a type of board intended for larger generators and installations than that just described, and distinguished from the latter by the use of 2-in. marble and a frame-work built up of vertical-angle irons resting on a channel iron and connected together by flat irons at the top. The standard boards, like Fig. 6, have a clear space of about 25 inches between the bottom of the marble and the floor. The marble rests on ornamental iron legs, which also serve to conceal the connecting wires and that portion of the angle iron frame which projects below the panels.

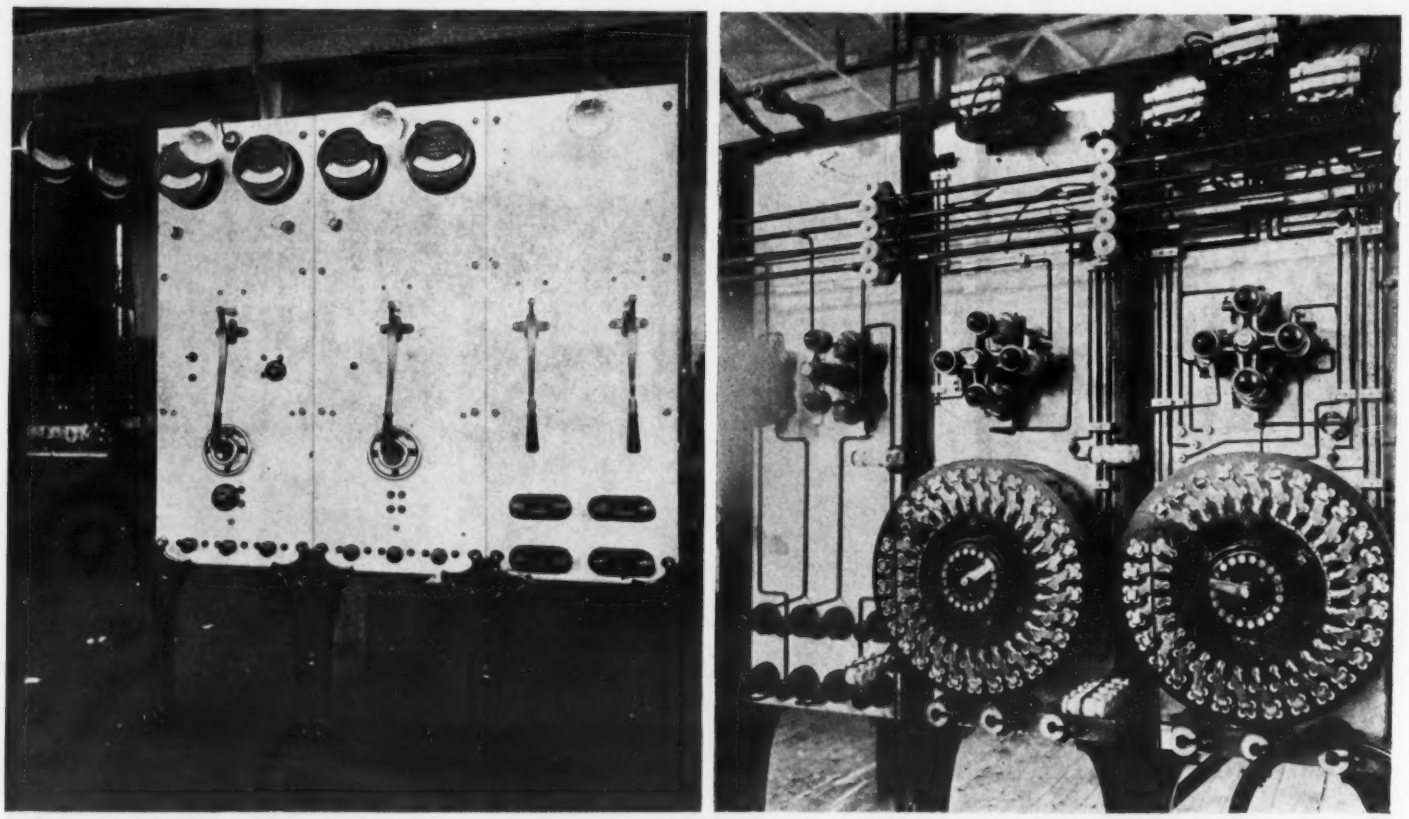
When it is necessary to install extra or special apparatus, it may be mounted on marble panels placed below the standard panels, the iron supporting legs being removed, and the smaller panels fastened directly to the frame. The remaining spaces may be fitted with blank marble for uniformity. One modification has the panels in a single slab, 65 in. high, while in another the panel is in two slabs, the top 1 ft. 8 in. high, and the bottom 3 ft. 9 in. This arrangement is to permit these alternating-current panels to match up properly with similar lines of direct-current panels.

Fig. 7 shows the rear of this same board, and illustrates the bus-bar structure, and the method of connecting the switch studs to the bus by means of copper straps and extension studs or "adapters." The bus-bars consist of copper straps 3 in. x ⅛ in. in section resting on porcelain insulators and supported on cast-iron brackets. This construction gives ample ventilation, ready inspection, and avoids use of any rubber insulation or other inflamable material, a point of great importance in switchboard work. All wires and bus-bars are thoroughly insulated by proper spacing apart in air and carried on porcelain insulators wherever necessary.

On this type of board, as a rule, the exciters for the generators can be controlled from the generator panel by means of field plugs or field switch and the exciter field rheostat. The limiting sizes of exciters for such control are 15 hp, 110 volts, and 20 hp and 220 volts. For larger exciters, or if meters are required, separate exciter panels must be provided.

Fig. 8 is the front view of this type of switchboard intended for the control of three three-phase feeders and two three-phase generators and shows the field ammeter, polyphase, indicating wattmeter and long scale ammeters used with this type of board—relatively a high-priced one. On the modified types field ammeters and indicating wattmeters are not, as a rule, supplied, and less expensive ammeters and voltmeters are used. Fig. 9 is a rear view of this board taken from the feeder end and illustrates the method used for mounting fuse blocks on the back of these panels. It also shows very clearly the porcelain spacing blocks between the bus-bars.

At the time these panels were designed they were only listed up to 250 volts, but since that time the underwriters' requirements have been modified and the switches rated at 250 volts direct current are permitted to be used on 440 volts alternating current. The type is provided with 600-volt switches, but as alternating-current generators are seldom wound for any voltage between 440 and 1,100 volts, these 600-volt switches are seldom used on these alternating-current panels. On alternating-current voltages up to 600 volts,



FIGS. 11 AND 12.—FRONT AND REAR VIEWS OF 1100—2200-VOLT SWITCHBOARD.

currents up to 1,000 amp. can readily be broken with a quick-break switch, so the limiting capacity for generators controlled by this type is about 1,000 amp., 440 volts, or, allowing for 90 per cent. power factor, about 800 kw, two-phase, and 650 kw, three-phase.

Fig. 11 is the front view of a board of the type here considered and shows the general appearance of the plunger switches, fuse blocks, meters, etc., on the front of the board. For these panels, plunger switches are supplied for operation at 1,100 and 2,200 volts. These switches, previously described, are made both single and double-break and all have the same carrying capacity, namely, 200 amp. The breaking capacity, however, is different for lighting and for power load and for different frequencies.

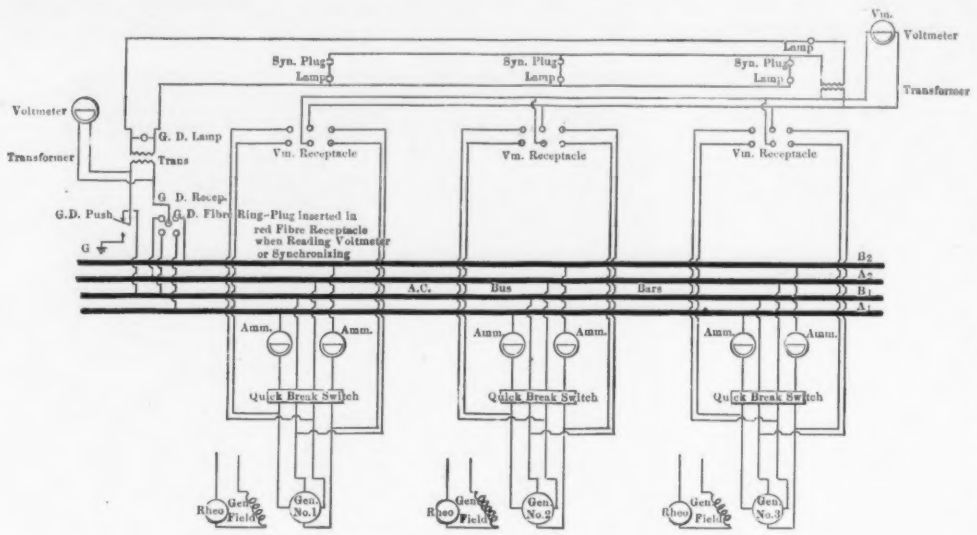


FIG. 13.—DIAGRAM OF CONNECTIONS OF 440-VOLT BOARD.

Character of load.	—Lighting load.—				—Power load.—			
Alternations	7200		16000		7200		16000	
Voltage	1100	2200	1100	2200	1100	2200	1100	2200
Cap. in amp. single-break .	100	50	100	50	60	25	25	15
Cap. in amp. double-break.	200	100	200	100	150	75	50	30

As the breaking capacity of the switch is the limiting factor on lighting loads where the power factor is .90 or above, these panels may be used up to 400 kw, two-phase, or 350 kw, three-phase, and on power load with a power factor of .75 or above the limits are respectively 300 kw and 250 kw.

The alternating-current generator field rheostat is mounted in most cases on the back of the generator panel with the exciter rheostat placed within the alternating frame. Both rheostats are independently operated by concentric handwheels on the front of the board. In the case of large generators only the rheostat face plate is on the switchboard, connection being made from it to the rheostat resistance which may be installed in any convenient place. As a rule, synchronizing is done by lamps, but when desired a synchroscope may be used and mounted on a swinging bracket at the end of the board.

The proper place for automatic protection is in the feeder circuits and fuses as a rule are satisfactory for circuits of the sizes usually controlled by these panels, i. e., less than 1,000 amp. at 440 volts, 200 amp. at 1,100, and 100 amp. at 2,200 volts. The low-voltage fuses furnished ordinarily are of the open type and are usually mounted apart from the switchboard in the outgoing feeders. Occasionally the open fuse blocks are arranged in gangs on slabs of suitable size and mounted on brackets on the back of the switchboard. Instead of open fuses a line of enclosed fuses has been designed and these occasionally are located on the front or rear of the board.

For 1,100 and 2,200-volt service, a lignum vitæ expulsion type fuse block is used with aluminum fuses enclosed in a chamber, which is air-tight except for one small vent. The melting of the fuse causes a rapid expansion of the air contained in this chamber and consequently creates a strong and quick air blast through the vent, blowing out the arc. Lignum vitæ being an extremely heavy, close-grained wood, cannot burn from the arc. It has great strength combined with considerable elasticity, and the tremendous expansive tendency produced by the arc is thus properly restrained, while just enough flexibility is allowed to avoid rupture. These fuse blocks are mounted at the bottom of the board, and the vent is so constructed that it discharges the fuse vapors downwards towards the floor.

The blocks containing the fuse are on the front of the panel, the terminals on the rear and plugs extending through the marble and forming part of the fuse holder, complete the connections between the terminals and the fuse. These fuse holders are readily detachable from the board and by having extra holders on hand already fused, the interruption to the service is reduced to a minimum. A new fuse can be inserted to replace the blown one, whenever convenient, and without the least danger to the attendant.

Fig. 12 shows the rear view of the board and illustrates the bus-bars, wiring, brackets, transformers, etc., used.

It is often deemed important that the generators and feeder panels be equipped with wattmeters, and it is customary to use indicating wattmeters on the generator panels and integrating meters on the feeders. The use of indicating wattmeters on the generator panels allows a ready means of determining when the fields of the machines are excited to give as high a power factor as possible. With the kilowatt output constant, the power factor will be a maximum when the armature current is a minimum, so the field current is adjusted until this minimum point is reached. Indicating wattmeters also show at a glance the output of the machine at all times. Instead of indicating wattmeters, power factor meters are sometimes used.

Integrating wattmeters on feeder panels keep a record in kilowatt-hours of the energy supplied to a feeder which supplies a certain section of a factory, a certain portion of a town, or a particular customer or set of customers, and by checking up these readings against those of the customer's meters, the actual commercial efficiency of the transmission line is readily obtained.

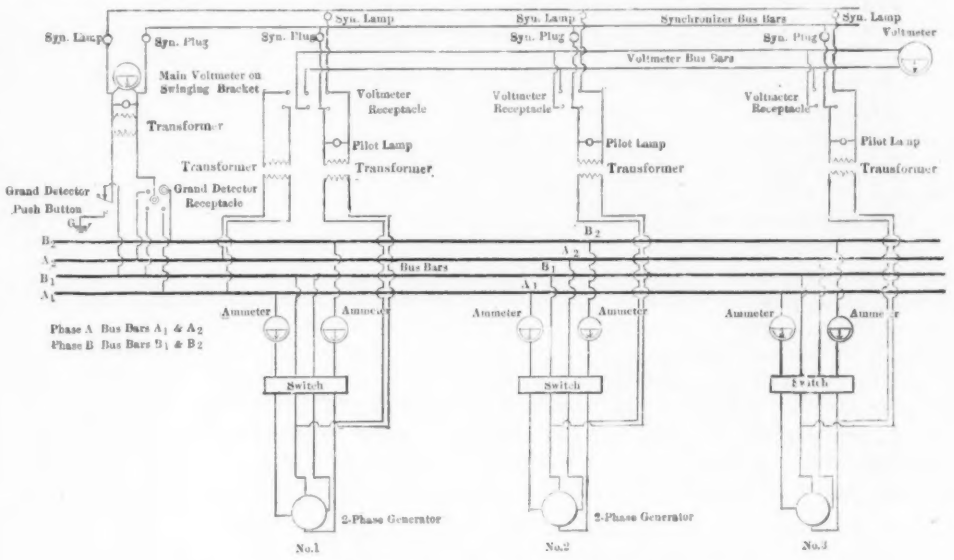


FIG. 14.—DIAGRAM OF CONNECTIONS OF 2200-VOLT BOARD.

The feeder panels are provided with one ammeter per feeder instead of one in each phase to allow two feeders to be controlled by one panel. The panels have an ammeter in each phase of a feeder, and are not as a rule arranged for double-throw systems; but the modified boards are provided with double-throw switches and two sets of bus-bars when required.

As single-phase lighting circuits are often run from 1,100 and 2,200-volt systems, suitable feeder panels for this line of work have been included in this type. These single-phase feeder panels are arranged usually with two feeders per panel and either with single or double-throw switches. On a two-phase switchboard with single-throw switches on feeder panels, these feeders are usually equally divided between the phases. With double-throw switches, the feeders can be thrown on one phase, or the other to balance up the load.

Fig. 13 is a diagram of connections with three 440-volt, two-phase generators operating in multiple. It shows the scheme used for ground detector, synchronizer and voltmeter connections. Field connections have been omitted to avoid confusion. When synchronizing the ground-detector plug is placed in a red receptacle the voltmeter plug put in on the right-hand side of a 6-point receptacle of the panel for the machine to be synchronized and the plug inserted in the synchronizer receptacle of same panel. Connections as shown are for synchronizing with dark lamps. If it is preferred to synchronize with bright lamps the connections of one of the transformers can be reversed.

Fig. 14 is the diagram of connections for a switchboard with three 2,200-volt, two-phase generators operating in multiple, and shows all of the connections except the field wiring.

Illinois State Electric Association.

Note was made in these pages last week of the opening sessions of the Illinois State Electric Association, at St. Louis, and the subsequent trip on the Mississippi.

At Alton, on Saturday night, September 19, the Alton Railway, Gas and Electric Company, through President J. F. Porter, entertained the association by a theater party. The trip up the river the next day, from Alton, was very enjoyable. The delegates were given an opportunity to see some of the beautiful but now comparatively little-known scenery along the Mississippi and Illinois rivers.

The only formal meeting of the Association was that held on the steamer for the election of officers. The old officers were all re-elected, as follows: W. E. McCullough, Beardstown Electric Light and Power Company, president; John W. Glidden, first vice-president: R. L. Allen, Economy Electric Light and Power Company, Joliet, Ill., second vice-president; C. L. Gerould, Galesburg Gas and Electric Company, third vice-president; D. Davis, Litchfield Electric Light and Power Company, treasurer; H. E. Chubbuck, Citizens' Lighting Company, La Salle, Ill., secretary; and W. B. McKinley, Urbana and Champaign Railway, Gas and Electric Company; J. N. C. Shumway, Taylorville Electric Company; Frank J. Baker, North Shore Electric Company, Waukegan; C. E. Hay and S. S. Davis, People's Power Company, Moline, Ill., executive committee.

Applications for membership were received from the Mt. Sterling Electric Light and Power Company and the Pana Electric Company. The place of the next meeting was left with the executive committee. Resolutions were passed, thanking the Fish Commission for its courtesy in allowing the association the use of the steamer Illinois; thanking the officers of the Alton Railway, Gas and Electric Company for the entertainment at that place; thanking the officers of the Louisiana Purchase Exposition for the courtesies extended while visiting the World's Fair grounds; thanking the St. Louis Transit Company for the use of a special car to and from the World's Fair grounds, and thanking the St. Louis Car Company for the reception and entertainment at that company's works in Baden, where a stop was made on the way up the river Saturday afternoon.

Convention of Electrical Workers.

The annual convention of the International Brotherhood of Electrical Workers was held in Salt Lake City, Sept. 14, there being about 250 delegates in attendance. The convention was presided over by Grand President W. A. Jackson. A resolution was passed voting $5,000 to the electrical workers at San Francisco, who are on a strike against the telephone company. There was a large electrical street display in honor of the occasion. The delegates were entertained in various ways during their stay in the city.

An Object Lesson in Telephone Receivers.—III.

By Arthur V. Abbott, C. E.

IN Fig. 56, published on page 517, last week, a somewhat different model of the Kellogg receiver is shown. Here a threaded block, b^3, is placed on the top of the magnet bars, which engages in a screw thread on the inside of the case. By this means adjustability is secured between the pole pieces and the diaphragm. Fig. 56 also illustrates the method of attaching the receiver cord. On the rear of the case is a cap, *e*, which is secured by means of a screw thread. Underneath this cap a partition is formed in the receiver

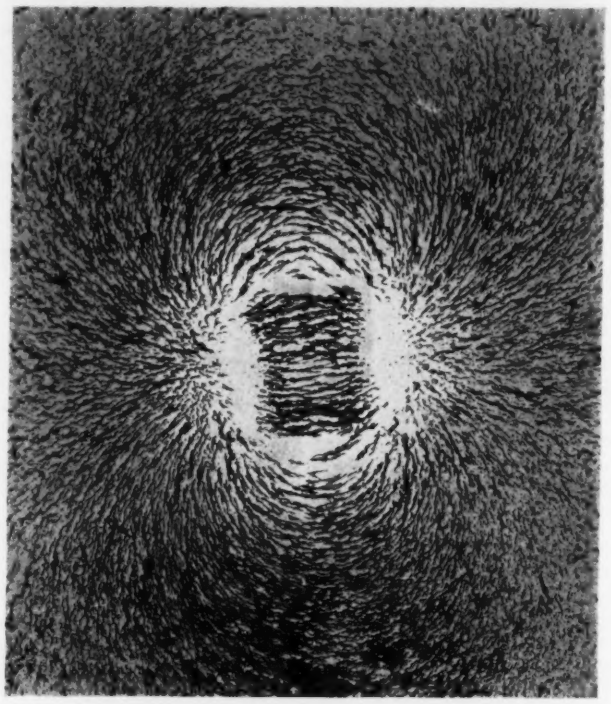


FIG. 57.—PHANTOM OF KELLOGG RECEIVER WITH DIAPHRAGM REMOVED.

case having a hole in its center. The leading-in wires from the line coils pass along through the case beside the magnet and through a hole in the center of the partition, a^2. On the top of this partition

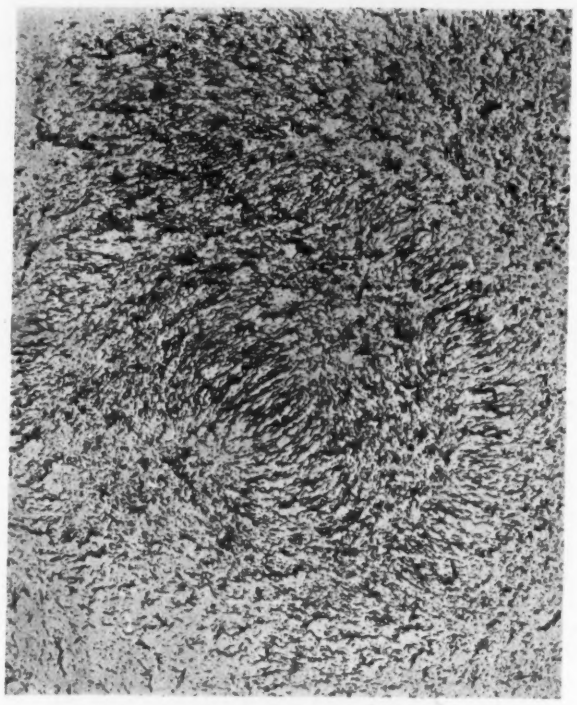


FIG. 58.—PHANTOM OF KELLOGG RECEIVER WITH DIAPHRAGM IN PLACE.

are two screws, *d*, to which the leading-in wires are attached. The receiver cord passes through a hole in the tail cap, *e*, and is then knotted at f^1. From the receiver cord the conductors pass to the

screws, d^1, thus securing electrical connection with the leading-in wires. Figs. 57 and 58 are the phantoms of the Kellogg receiver, Fig. 57 is taken with the diaphragm removed, while Fig. 58 shows the field with the diaphragm in place. The phantom of Fig. 57 is noticeable for the uniformity of the field which is produced, while Fig. 58 indicates that the magnetic relations between the diaphragm and the field are well preserved, as there is little or no evidence of any external field outside of the diaphragm.

THE MANHATTAN TELEPHONE RECEIVER.

The Manhattan hand telephone is illustrated in Figs. 53, 59 and 60. Fig. 53B shows the instrument assembled, while in Fig. 59 it is

FIG. 59.—MANHATTAN HAND-TELEPHONE DISSECTED.

dissected. The case consists of three pieces: the body, the diaphragm cap and a tail piece, which is simply a composition disc, carrying two binding posts, through the center of which a screw runs into the interior of the instrument and is tapped into the magnetic system. The magnetic system consists of two bars of steel .628 in. wide, .120 in. thick and 3.75 in. long. In the rear the bars are clamped together by means of a screw bolt and a filling piece of soft iron, while in front there is a filling piece cast of non-magnetic metal that car-

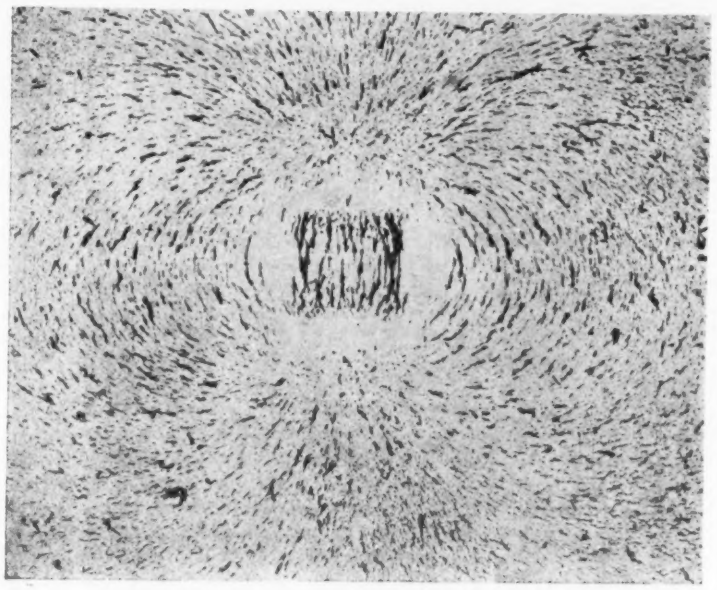


FIG. 60.—PHANTOM OF MANHATTAN HAND-TELEPHONE.

ries a screw thread which engages with a similar thread on the inside of the case. This block is also provided with a shoulder and presumably the magnetic system is to be screwed into the case until the shoulder reaches a bearing. This receiver is noticeable in having no pole pieces. The magnet bars extend directly through the composition block and on to their ends the line spools are forced. The spools are .44 in. wide, 1.0 in. long and .43 in. deep. The winding is of No. 34 or No. 36 wire and the resistance from 68 to 70 ohms, both of the line coils being joined in series. The diaphragm is flat, of ferrotype metal .01 in. thick, 2.25 in. in diameter over all, and 1.75 in. free diameter. The tractive effort is .851 pounds, corresponding to 369 grams. This is equivalent to a tractive effort of 1,216 grams per square cm., showing an induction of 5,500 gausses in the pole pieces, and remanance the same in the magnets. The leading-in wires pass from the line spools through two slots in the composition filling piece and thence extend to the rear of the receiver and are soldered into the binding posts. The leading-in wires are carefully insulated with rubber tube to prevent any possibility of crosses. Fig. 60 is the phantom from the Manhattan model with the diaphragm removed. The field is exceptionally symmetric and uniform and is noticeably less intense than that of other models, which is fully substantiated by a lower tractive effort.

THE MANHATTAN HEAD TELEPHONE.

The Manhattan head telephone is a curious model in many re-

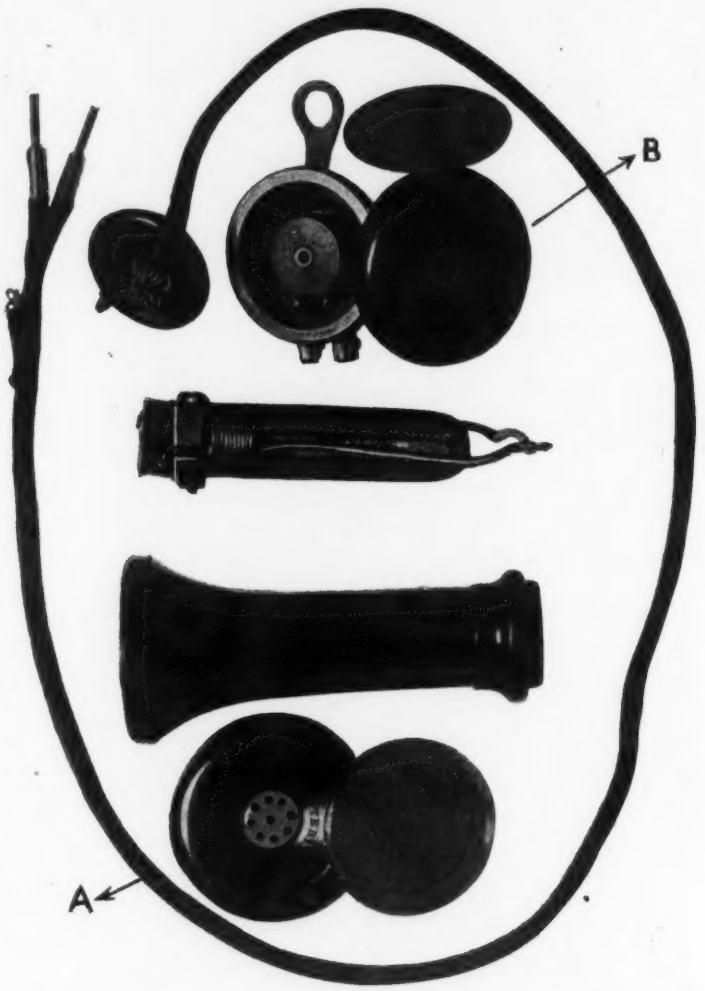


FIG. 61.—A—WESTERN TELEPHONE RECEIVER DISSECTED.
B—MANHATTAN WATCH-CASE RECEIVER DISSECTED.

spects. It is illustrated in Figs. 54, 61, 62 and 63. In Fig. 54B the instrument is shown assembled, while in Fig. 61B it is dissected. The instrument consists of a wash bowl-shaped casting of hard iron or steel. In the center of this a small round hard steel stud is secured, which extends upwards and is faced off even with the rim of the casting. Around this central stud is a wooden spool, which carries the line coil. Through the side of the case two holes are drilled and are furnished with small binding posts to which the cord tips may be attached and from which the leading-in wires pass to the spool. The diaphragm is flat, of ferrotype, .005 in. in thickness, 2 in. in diameter over all and 1.75 in. free diameter. The exciting coil is a single spool of wood 1 in. in diameter and .312 in. deep. The receiver is wound with No. 38 wire to 70 to 80 ohms. The pole piece, if it may be so termed, is a steel stud .280 in. outside

The tractive effort is .344 pounds, corresponding to 156 grams. This is equivalent to 276 grams per sq. cm., showing an induction of 5,300 gausses in the pole piece. The phantoms of this model are shown in Figs. 62 and 63 (Fig. 62), being the phantom with the diaphragm removed, while Fig. 63 is that taken with the diaphragm in place. The field shown in Fig. 62 is a curious one, but is what would naturally be expected from a magnetic system designed upon the lines of this model. The effect of the central magnet is clearly shown. In Fig. 63 the phantom taken with diaphragm in place it

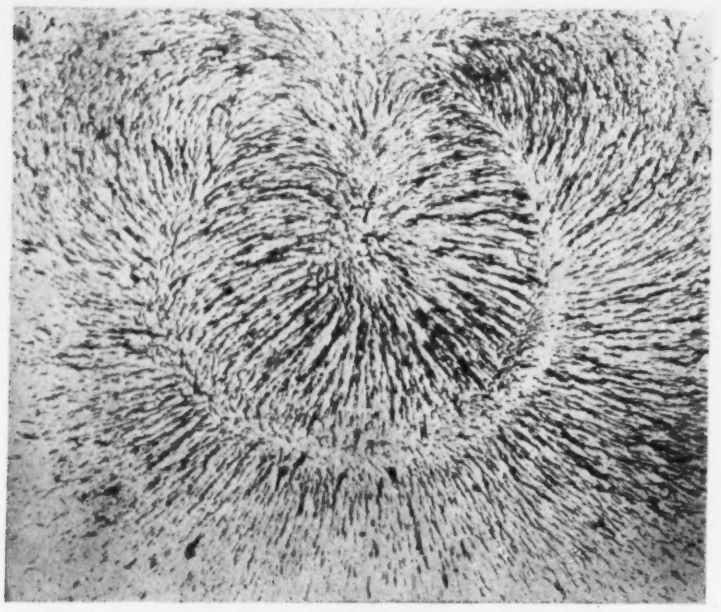


FIG. 62.—PHANTOM OF MANHATTAN WATCH-CASE RECEIVER WITH DIAPHRAGM REMOVED.

is curious to notice that the reluctance of the diaphragm is sufficient to cause a noticeable magnetic leakage from the circumference of the casting which forms the case of the instrument.

RECEIVER OF THE ERICKSON TELEPHONE COMPANY.

The model adopted by the Erickson Telephone Company is shown in Fig. 53c and in Figs. 64, 65 and 66. Fig. 53c illustrates the receiver assembled, while in Fig. 64 it is dissected, Figs. 65 and 66

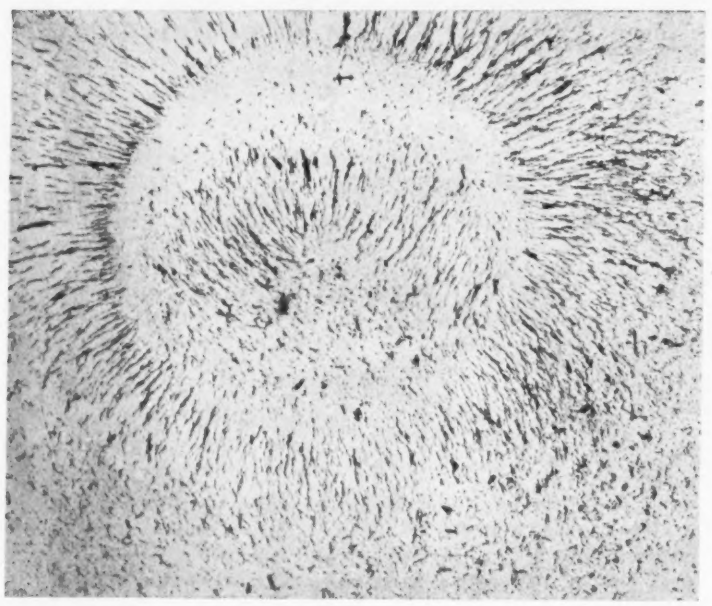


FIG. 63.—PHANTOM OF MANHATTAN WATCH-CASE RECEIVER WITH DIAPHRAGM IN PLACE.

being the phantoms. In this receiver a pressed brass case forms the foundation of the instrument over the handle portion of which a tube of rubber or other insulating material is slipped, which is furnished with a tail piece that carries the binding posts to which the receiver cord is attached and in the center of which is a screw eye to which a supplementary cord is knotted to support the receiver and relieve binding posts and cord conductors of any strain. In this respect this model is a departure from those that have been previously considered, for the foundation in the case is entirely metallic and merely enough insulation provided to protect the receiver. The magnetic system consists of a U bar .622 in. wide and .20 in. thick; the magnet is 4 in. long. Each pole piece is bolted to

FIG. 64.—ERICSSON RECEIVER DISSECTED.

its appropriate side of the U by means of a bolt and nut. The pole pieces are .573 in. wide, .115 in. thick and .970 in. long. The tractive effort is 2.595 pounds (corresponding to 1,177 grams). This corresponds with tractive effort 1,315 grams per sq. cm., the induction in the pole pieces is 11,600 gausses, and the remanance is 6,000 gausses. The line coils are of brass .41 in. wide, .88 in. long and .31 in. deep. The receiver is wound with No. 36 wire with about 2,000 turns and has a resistance of 120 to 125 ohms. After

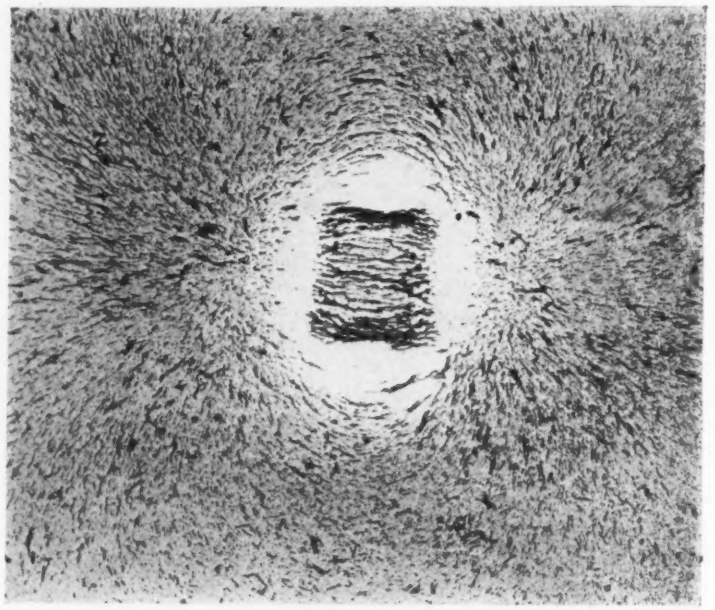


FIG. 65.—PHANTOM OF ERICSSON RECEIVER WITH DIAPHRAGM REMOVED.

the magnetic system is slipped in the side of the case two holes are bored through the sides of the case and the magnet bars, and two screws inserted from the exterior. By this means the case and magnets are bolted firmly together. The sorew holes in the case are slightly elongated and thus it is possible to adjust the pole pieces with reference to the diaphragm. The surface of the case is faced

off and the diaphragm by means of the cap clamped firmly upon the exterior of the shell. The leading-in wires are insulated with a double covered paraffined cotton. They are attached directly to the line coil wire and thence carried backward to the case and soldered to the binding posts. The diaphragm is flat, of tin .01 in.

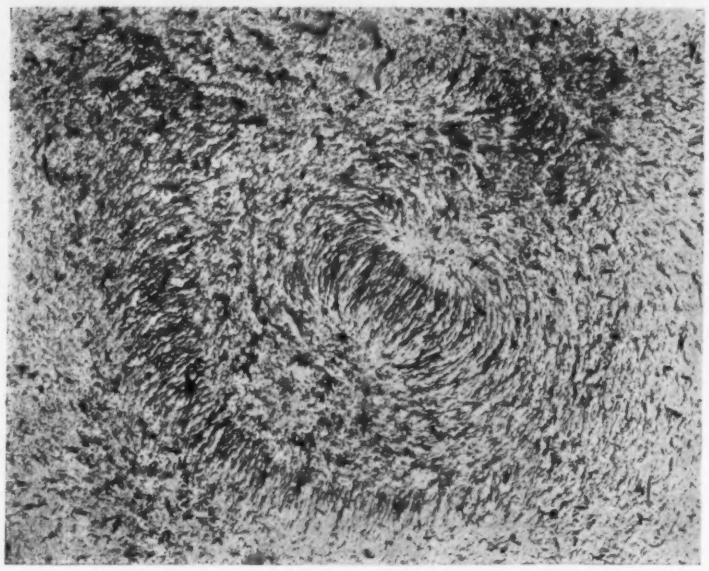


FIG. 66.—PHANTOM OF ERICSSON RECEIVER WITH DIAPHRAGM IN PLACE.

thick, 2.31 in. in diameter over all, giving 2 in. in free diameter. The phantoms of this model shown in Figs. 65 and 66 are noticeable. Fig. 65 shows a field that is exceedingly uniform and intense. The phantom of Fig. 66 is taken with the diaphragm in place and shows a uniform distribution of field and that the diaphragm is slightly above saturation.

Electric Trolley Lines in Germany.

A recent report from U. S. Consul H. W. Harris, Mannheim, Baden, deals with street-car lines in Germany. Recently published figures, he says, place the total number of miles of electric car lines in Germany at 2,117. Considering the area and population of the Empire, these figures show a comparatively slow development of this branch of railway building—this, too, in spite of the fact that in electric lighting and in other applications of electricity Germany had taken advanced rank. The cause of this backwardness is to be sought mainly in the fact of State ownership of the larger part of the existing steam railways, and the unwillingness on the part of city and other authorities to grant charters to private companies.

The Grand Duchy of Baden, a small part of the Empire, has an area slightly larger than that of the State of Connecticut, with a population somewhat more than twice as great. In 1900 it had five cities of upward of 40,000 population, namely, Mannheim, Carlsruhe, Frieburg, Pforzheim and Heidelberg. There were in 1900 fourteen cities of upward of 10,000 population. The State includes a thickly settled portion of the Rhine Valley about 160 miles long, with an average width of 10 miles, which would seem to be a specially good field for electric railway lines. And yet at present electric lines are in operation only in or near the following cities:

	Length of line. Miles.
Mannheim (including Ludwigshafen extension)	25
Carlsruhe (including line to Durlach)	9
Heidelberg (including Heidelberg-Wiesloch line)	11½
Freiburg	8

The city of Kehl, Baden, is connected with Strassburg by a branch of the Strassburg city lines, but does not operate an independent line. Of the above lines, each belongs to the respective city except in the case of the Heidelberg city lines, which are operated by a private corporation, the city being the owner of three-quarters of the capital stock.

The fare charged carries with the distance long rides and transfers on a single fare not being permitted to the extent they are in the United States. The fare for ordinary distances is 10 pfennigs (2½ cents), tickets good for 25 rides being sold for 2 marks (48 cents).

A Proof of the Law for Grouping Cells to Obtain Maximum Current.

BY E. DANA PIERCE.

SUPPOSE we have a circuit of known resistance, R, to which we wish to furnish current from a given number of similar galvanic cells (or other direct-current generators), each of an e.m.f., e, and internal resistance, r. To obtain the maximum current we must so connect the cells in series-parallel groups that the total internal resistance of the battery shall be as nearly as possible equal to R, the resistance of the external circuit. This principle is usually stated without proof in elementary text-books of physics. Its truth may be easily verified by trying a few test cases, and it may also readily be proved by the use of calculus. It is the purpose of this article to give a simple algebraic proof which is mathematically complete and also capable of being understood by any one familiar with simple algebra:

Let I = current.
e = e.m.f. of one cell.
r = internal resistance of one cell.
R = external resistance of circuit.
p = number of cells in each "parallel" set.
s = number of such sets in series.

Then for any given number of cells, n,

Let $n = p\,s$, (1)

$$n = \frac{1}{k} \tag{2}$$

Then $$p\,s = \frac{1}{k} \tag{3}$$

$$p = \frac{1}{s\,k} \tag{4}$$

Now, by Ohm's law, we have

$$I = \frac{e\,s}{R + r \times \frac{s}{p}} = \frac{e\,s}{R + r\,k\,s^2} \tag{5}$$

It is to be proved that I in the last equation will be a maximum when $R = r\,k\,s^2$. (6)

To prove this by calculus we differentiate I with respect to s in (5), and obtain

$$\frac{d\,I}{d\,s} = \frac{e\,(R - r\,k\,s^2)}{(R + r\,k\,s^2)^2} \tag{7}$$

For a maximum value of I, the second member of (7) is put equal to zero:

$$\frac{e\,(R - r\,k\,s^2)}{(R + r\,k\,s^2)^2} = 0; \tag{8}$$

or, $$e\,(R - r\,k\,s^2) = 0. \tag{9}$$

$$R = r\,k\,s^2 \tag{10}$$

That is, the external and internal resistances must be equal for maximum current.

The algebraic proof of this proposition is as follows, using the same symbols:

In any case, the total *internal* resistance is

$$r \times \frac{s}{p} = r\,k\,s^2 \qquad \text{(from [4])}$$

Now, $r\,k\,s^2$ is either equal to R, i. e.,

$$R = r\,k\,s^2 \tag{11}$$

or $r\,k\,s^2$ equals R plus or minus some quantity, i. e.,

$$r\,k\,s^2 = R \pm d. \tag{12}$$

Assuming first (11), we have

$$s = \sqrt{\frac{R}{r\,k}} \qquad (13)$$

and substituting this value of s into (5), we have ($r\,k\,s^2 = R$).

$$I_1 = \frac{e\ \sqrt{\frac{R}{r\,k}}}{2\,R} \qquad (14)$$

But if we assume the condition of equation (12), then

$$s = \sqrt{\frac{R \pm d}{r\,k}} \qquad (15)$$

and from (5) we have the current value for this case ($r\,k\,s^2 = R \pm d$),

$$I_2 = \frac{e\ \sqrt{R \pm d}}{2\,R \pm d} \qquad (16)$$

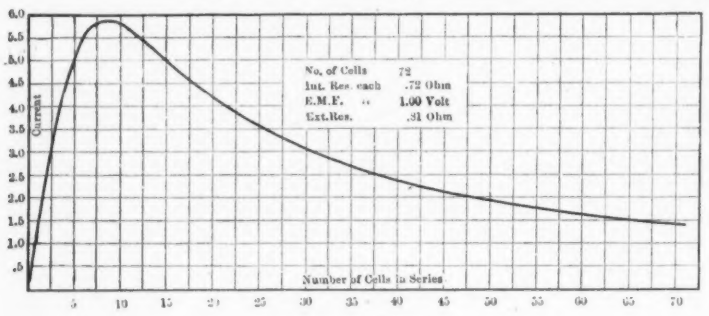
It remains to be shown that I_1 of (14) is greater than I_2 of (16). Expressing the ratio of I_1 to I_2 from (14) and (16),

$$\frac{I_1}{I_2} = \frac{(2R \pm d)\ \sqrt{R}}{2R\ \sqrt{R \pm d}}$$

$$= \frac{2\,R \pm d}{2\,\sqrt{R\,(R \pm d)}}$$

$$= \sqrt{\frac{4\,R^2 \pm 4\,R\,d + d^2}{4\,R^2 \pm 4\,R\,d}}$$

But here, since d^2 is essentially *positive* (that is, whether d is a plus or a minus quantity), the numerator of the fraction is greater than the denominator, and, therefore, I_1, the current value when the external and internal resistances are equal, is proved greater than the current value when they are unequal.



CURRENT CURVE.

The diagram gives the curve obtained by plotting the number of cells in series, s, as abscissæ, and I, current values, as ordinates for a given numerical case.

It will be seen from the curve that there is one and only one maximum value for the current, and that this is represented by the top of the curve where the external and internal resistances are equal, namely, .81 ohms.

It is also evident from the curve that the rate of decrease of current with changing number of cells connected in series is not the same on the two sides of the maximum.

A New Journal of Physical Chemistry.

The first issue has appeared, dated July, of the *Journal de Chimie Physique*, published in Geneva, Switzerland, under the editorship of Prof. P. A. Guye. In a list given of collaborators appear the names of Arrhenius, Berthelot, Curie, Duhew, Guillaume, Heroult, van't Hoff, Le Chatelier, Mond, Morley (Cleveland, O.), Nernst, Ostwald, Poincaré, and other names well known in chemical and physical science. The journal will appear monthly at a subscription price of 25 francs per annum.

A Possible Source for Securing Wide Speed Range in Direct-Current Motors.

BY ALBERT F. HEMINGWAY.

THE work of constructing an electric motor capable of wide speed variation was first attempted with the supposition in mind that the problem would consist in the use of greater bulk of copper and iron within the motor itself, as a substitute for foreign accessories, armature resistances, special systems, gearing, etc., now largely employed for obtaining speed changes, all of which are accompanied by undesirable complications more or less inefficient and expensive. I refer here, of course, to a motor in which the speed variations are accomplished by varying the magnetic density of the field magnets, the manipulation for such speed changes being accomplished by adjusting a variable resistance in circuit and through which the current passes to the field magnet coil. Preliminary determinations on the subject show at once the impossibility of obtaining a design productive of anything like a satisfactory range of variation. In fact, about all that is possible is being daily accomplished by a number of electrical manufacturing companies. I believe a speed ratio of two to one is about the practical limit.

The obstacles preventing results may readily be noted by the following summary:

First. Arcing at the commutator when the magnetic field is abnormally reduced, owing to distortion created by armature reaction.

Second. Under normal conditions of design, not sufficient cross-section of magnet cores to convey additional magnetism, even if provided for by field coils.

Third. Assuming normal proportions, if provision be made for reducing speed by increasing the density of the magnetic flux, field core dimensions, armature diameter and length must proportionately increase. Thereby each turn of wire upon the armature encircles a corresponding greater section of iron; and the effect of the armature current becomes greater in the same degree as the proportions have grown. So that in retaining torque, it will be found impossible to approach the maximum speed originally established without excessive arcing at the commutator; and altogether, so far as the per cent. of variation is concerned, very little is gained by increasing the normal proportions.

In any type of machine a definite ratio between armature and field magnetism, or the coil energy producing it, must be had to obtain satisfactory commutation, and as is readily observed from the foregoing, speed may be reduced, but not successfully varied.

It is true that there is in existence a large number of methods and auxiliary devices for counteracting armature reaction. The foremost and more important of these consists, in principal, of maintaining a powerful and permanent saturation at the polar extremities of each magnet pole, by suitably shaping the projections or through the use of auxiliary coils. These devices are familiar to all, and conform with the theory that at the point of commutation the current circulating in the armature is caused to change its course.

Where the work of reversal is forced by the commutator brush forming connection with the coil through the commutator bar, commutation is said to be poor, and worse if the coil undergoing reversal is at that moment within a field tending to excite an e.m.f. contrary in direction to the course the current takes in leaving the armature. Commutation is said to be best when the coil undergoing commutation is within a field tending to assist the reversal; in other words, the coil being within a field tending to excite an e.m.f. opposite in direction to that of the other coils in the advancing side of the armature. The function of these devices, as previously noted, is to maintain this proper shading or fringe of magnetism stable at the point of commutation, regardless of load or distortion taking place at other points of the polar surface.

Another method that has gained considerable attention is that applied in the Thompson-Ryan dynamo, wherein coils through which the armature current flows are suitably disposed upon the polar face of each pole. The magnetism created by these coils is opposite to that of the armature and is intended to counterbalance armature reaction. Primarily the aim of any of these inventions is to obtain arcless operation at the commutator with a fixed position of the brushes.

Between zero and full load of a dynamo or motor there is on the one hand a condition where armature reaction is at a minimum, and on the other a maximum; but it has become quite general with many dynamo designers to overlook any auxiliary methods for the

suppresion of arcing at the commutator, the practice being to construct a massive and stiff field, offering little opportunity for distortion at maximum load, and consequently not in need of brush adjustment. Giving consideration to any such devices for use when speed is to be varied, by varying the field magnetism, records as to the satisfaction given would not warrant an expenditure of effort along these lines. The problem of building a motor or dynamo that will not arc at the commutator between zero and maximum load is, comparatively speaking, a simpler matter than the building of one in which this condition is not only to be maintained, but arcing is to be avoided between great variations of field density and speed.

After some study and searching as to the availability of any such existing device for the suppression of arcing at the commutator that could be used to advantage in variable-speed motors, the writer came across in the London *Electrical Engineer* in the issue of October 12, 1900, a contribution of some length entitled "A Continuous-Current Dynamo for Widely-Varying Voltage, Designed by E. Lanhoffe."

In this dynamo two or more magnet yokes are arranged in tandem common to a single armature, and it is claimed to have remarkable speed and voltage-varying characteristics. One of the field yokes is maintained at a maximum density, while the other is varied and capable of being reversed. A five to one ratio of speed or voltage variation is stated to be possible. Although the article is adversely criticised by the editors of the journal in which it appears, there is reason for expecting as good results with this method as with any other. One method at present on the market for varying speed by varying magnetic density, consists in adjusting by inward and outward travel the centers of the motors' poles or field cores, leaving the border fixed and in permanent relation with the armature, thus maintaining at the polar projections a saturated and stable fringe. By the preceding plan of double yokes, the results should not materially differ.

In the development of dynamo construction the tendency has been towards increasing the number of poles, and theoretical considerations demonstrate that an increase in the number of poles aids materially in obtaining arcless operation at the commutator. A machine having a large number of poles is capable of greater variations in field density without arcing than one of a lesser number; that is, assuming a machine of normal design and known capacity at maximum speed, to obtain speed reduction will require a corresponding increase in field core dimensions, and as previously noted, a larger armature with proportionate increase in armature reaction. If, however, this increase can be made to take the form of additional poles, the armature turns remaining the same in number, owing to the decrease of angular span of each armature coil, it does not encircle as great a section of iron, and consequently the armature reaction does not increase with the increased dimensions. A design to withstand considerable field strength variation is thus a possibility until the external dimensions reach an undesirable diameter, which follows from the fact that under ordinary circumstances diameters are much greater than length; and, therefore, can meet with but limited success where symmetry of outside proportions are to be normal.

Multiplying the number of poles by arranging yokes in tandem has the advantage that each yoke is only susceptible to the armature reaction of that portion of the armature enclosed by it, although, where the yokes are doubled, armature length and reaction are doubled. Once the best design has been arrived at for a single yoke, the question remains whether there is anything to be gained by adding the second yoke.

It is self-evident that by the addition of a second yoke, equivalent in magnetic density to the first, the speed would be reduced one-half. By varying one of them to zero, the speed is brought back to that of one, and by reversing the polarity, the counter e.m.f. of the armature is reduced, because of the reverse field, and the speed increases as a result. The complications arising at this stage make it difficult to predetermine without tests as to what effect this combination would have upon arcless operation.

If one of the yokes has its poles shaped and situated for the best operating conditions with respect to commutating fringe, the poles of the yokes undergoing varying densities will take a central position well within the boundary of the polar prospections of the other. That is, the magnetic flux of the yoke undergoing change and reversal enters the armature at a point midway between the armature coils undergoing commutation, being so applied as not to interfere with the magnetic fringe for proper commutation established by the first yoke. If the poles of both yokes to be alike, when operating with one reversed, the distortion due to armature reaction arises from a peculiar influence. It would appear, assuming it a possibility, to reach the condition where the poles of each yoke are oppositely energized, when the commutating fringe would take an ideal position because of the counteracting influence of the two divisions of the magnetic circuit.

The foregoing is in line with the type of construction conceived by the author to satisfactorily meet the conditions of reasonable speed variation in direct-current motors, and is offered as nearest to any in producing fruitful results.

An electric motor capable of giving a wide range of speed is a great necessity. If it can be attained without freakish and elaborate designs it will be gladly received by a large percentage of motor users. We can safely assume that so long as the applied magnetic field maintains stable relations with that portion of the armature winding undergoing commutation, arcing during commutation is a minimum, regardless of the varying density within this polar border.

A notable instance of a design of pole in which this method takes direct form is one referred to among others under the heading of "methods for counteracting armature reaction in direct-current dynamos" in the work of Sylvanus P. Thompson, wherein each pole is provided with three energizing coils. A large shunt coil with coils connected in series with the armature circuit is placed upon the upper and lower polar propections. By means of these polar divisions, the portions constituting the polar propections are maintained saturated, and consequently retain a powerful fringe at the proper point for commutation, no matter what the variations and load may be, or what distortion due to armature reaction befalls the larger middle pole. It is not necessary to point out the limitations of this arrangement for extensive speed variation, although the difference between this and the preceding plan, that of double yokes, is one of adopting the same underlying principle to greater structural advantage in the case of the double yokes.

The type of construction conceived by the author utilizes a second magnetic yoke, also a second armature, both armatures being common to the one shaft. The second armature may be considerably narrower than the first, and the ratio between armature and field ampere-turns need not be great. The windings of both armatures are connected in series at each armature coil, employing only one commutator. The field poles of the second yoke are calculated to take a central position well within the commutating border of the poles of the first yoke. Owing to the large number of turns on the second armature, a comparatively small field is needed, which is varied and reversed for speed variations. The first or main yoke is massive and calculated in itself to have, so far as it is possible, characteristics conducive to arcless commutation within speed and load variations, by means of a high ratio between armature and field ampere-turns, a maximum number of poles, and a compound field winding in addition to the shunt.

The secondary division of the motor is entirely relied upon to give the speed variations by varying and reversing its field, its functions being similar to the interposition of an external generator, generating a variable and controllable e.m.f. motor force, commonly known as the booster or teaser method, but with less apparatus.

Development in Cuba.

A recent report to the U. S. State Department from Cuba gives the revenue from posts and telegraphs from May 20, 1902, when the Republic was established, to December 31, as $279,479. As to water power development, it is said: Water power has been very little employed in Cuba, although a great many rivers and creeks of considerable capacity exist to supply power. The Almendares River, which passes through the outskirts of Habana on the west side, supplies the city and suburbs at present with 1,200 hp for a paper mill, brewery, and other turbines already established of 250 hp each. By going farther up more power may be obtained without causing great damage to the others below. Mayabeque River, in Guines, Province of Habana, was, until a few years ago, supplying power to run two sugar plantations. The water employed then is now used in irrigation. In the San Juan River, Matanzas, there is a turbine established to run an ice factory. Water power is not known to be used anywhere else in the whole island.

High-Speed Electric Railway Work in Germany.

The fact that in the renewed trials on the Marienfelde-Zossen military railroad an electric car made a speed last week at the rate of 118 miles an hour, gives special interest to the subjoined details of the plan under which the experiments are being carried out:

The Studien-Gesellschaft für Elektrische Schnellbahnen (which is the name of the German corporation which has financed and conducted the high-speed trials), has just issued its third report, covering the year 1902. The board of directors consists of 18 members, among whom are Ernst Borsig, the chief of the great Borsig works; Geheimrat Moritz Lochner, Geheimrat Emil Rathenau, general manager of the Allgemeine Electricitäts Gesellschaft, now in this country; Adolf Schmidt, director of Friedrich Krupp, Essen; Wilhelm von Siemens, Prof. Adolf Slaby, and Geheimrat R. Ulbricht, president of the German Association of Electrical Engineers. The technical board consists of 29 members, many of whom are engineers of international reputation.

The report reads, in effect, as follows: "As already mentioned in our last annual report, the Prussian Secretary of Public Works (Minister der Öffentlichen Arbeiten) has offered to supply the new rails required for the construction of a more solid road on the experimental line. In order, however, to obtain a road which shall be sufficiently solid to stand even the highest contemplated speeds, it was considered necessary to renew also the whole roadbed and to provide the greater part of the experimental line with a guide rail on the inside of each of the two running rails. This programme required a considerable expenditure, estimated at $75,000. As the members of the Studiengesellschaft had already been assessed for an extra 50 per cent. above the original capital, the association was unable to raise this money. The more credit is, therefore, due to the Prussian Secretary of Public Works, who, on the request of the Studiengesellschaft, placed the above sum in the budget of the Prussian Railroad Department for 1903, and to the Prussian Parliament, which voted a grant of this sum. Thanks are also due to the Prussian Secretary of War (Kriegsminister) who has permitted the construction of the new roadbed by the Eisenbahn Brigade (a corps of the German army specially trained in erecting railways and in general engineering work).

"Under these circumstances it was not possible to make trial runs at high speeds during the last year, and the time was spent to advantage for other purposes. Preparations were made for the coming experiments; the designs of the high-speed railroad cars were improved on the basis of experience gathered from previous trials; experiments were also made with a three-phase locomotive, built by the Siemens & Halske Company, with high-voltage motors, and a larger number of trial runs were made with the high-speed cars. The experiments with the three-phase locomotive have shown that it is possible to build motors to take current direct from the 12,000-volt, high-pressure mains, thus making it unnecessary to carry heavy and expensive transformers on the cars.

"Although on account of the lightness of the rails no higher speed than 125 km. (74 miles) per hour could be attempted in the former runs with the high-speed cars, yet it was possible to make with the lower speeds detailed tests and investigations of the electric equipment of the cars, of the resistance of the cars, of the air resistance and the most favorable form for the front walls of the trains, as well as measurements of the electric power, the lateral oscillating vibrations of the cars and the effect on the rails. The results of these experiments offer a valuable basis for devising the plan of the runs on the new roadbed and for the design of new high-speed cars.

"For the trial runs on the new roadbed the original intention was to provide both cars with eight-wheel trucks; when the design was worked out in greater detail it was found, however, that to make the eight-wheel trucks effective, they would have to be given dimensions for which the space below the cars was not sufficient. It was, therefore, decided to employ six-wheel trucks instead of eight-wheel trucks; the final design having been chosen according to a decision of a sub-committee of the board of directors, in agreement with the electric manufacturing companies and Messrs. van der Zypen & Charlier. The former, who had promised to provide the cars at their own expense with eight-wheel trucks, have agreed to do the same with the six-wheel trucks. The new trucks are being built and it is hoped that in the trial runs to be made during the summer of 1903 on the new roadbed, a speed of 200 km (120 miles) per hour will be reached."

The above is all the technical information contained in the report. Concerning the financial situation, it is stated that the expenses in 1902 consisted of general expenses, the purchase of measuring instruments, the maintenance of cars, road and electric transmission line, etc. The exact amount of these expenses for which the board of directors has granted $12,500, cannot yet be given, but it is thought that the expenses have not been beyond the amount granted. According to the report the former expenses were as follows:

	$287,500
General expenses to end of March, 1903	10,250
Expenses for trial runs in 1902	12,500
Total expenses up to date	$310,250
The original capital with 50 per cent extra assessments was	$281,250
Income in interest up to date	2,500
Total	$283,750

Under the assumption that about $50,000 more can be made available, the difference between $333,750 and $310,250, i. e., $23,500, is at the disposal of the Studiengesellschaft, and it is believed that this amount will be sufficient to finish the experiments this year.

It would appear from the cable dispatches that the high-speed run noted above was made by the Siemens-Halske locomotive, taking current directly from the feed wires at 13,500 volts.

Residual Charge of a Condenser.

By J. J. Cort.

In the ordinary theory of the condenser the charge is assumed to be strictly proportional to the charging e.m.f. This simple proportionality, however, is not strictly true, for there is a "soaking-in" and "soaking-out" effect in charging or discharging a condenser which is analogous to the elastic lag of glass.

When a given constant bending force is applied to a glass rod the rod will take a large bend promptly and then for several hours the bend will increase very slowly; or when a bent glass rod which has been subjected to a given constant bending force is released,

CURVE OF DISCHARGE DEFLECTIONS.

the rod will quickly become very nearly straight, and then for several hours slowly settle into its unstrained condition.

In an exactly analogous way when an e.m.f. is connected through a low-resistance to a condenser, there will flow into the condenser a sudden pulse of current which quickly drops to a very small value, continuing for several hours and gradually falling to zero. (In this statement the very small leakage current due to imperfect insulation of the condenser is ignored.) This lingering current may be termed the "soaking in" current. Or when a charged condenser is connected to a low-resistance discharging circuit, there will flow out of the condenser a sudden pulse of current which quickly drops to a small value, continuing for several hours and gradually falling

to zero. This lingering current may be termed the "soaking-out" current.

In any ordinary commercial condenser the value of this lingering current that flows during the "soaking-in" or "soaking-out" period is too small to be measured directly; but if a charged condenser is momentarily connected to a low-resistance discharging circuit and then insulated, the "soaking-out" current will accumulate in the condenser, constituting a residual charge. The value of this charge may be observed by discharging the condenser a second time through a ballistic galvanometer.

In obtaining the data for the accompanying curve, a two-microfarad condenser was used, this condenser being charged by connecting it for five minutes to five small dry batteries in series. The condenser was then discharged by connecting it for a moment to a low-resistance discharging circuit of seventy ohms, after which it was allowed to stand insulated for ten seconds, when it was discharged a second time through a D'Arsonval galvanometer and the deflection observed. This same process was repeated a number of times, except that the time during which the condenser was allowed to stand insulated before the second discharge was varied, being increased by ten seconds each time.

The Institute's New President.

Following are the remarks of Mr. Bion J. Arnold upon assuming the presidency of the American Institute of Electrical Engineers:

The remarkable development and growth of our body during the past two years has introduced many new elements which must stand the test of time and possibly be tried in a period of financial depression. Our energies, therefore, should be directed toward carrying forward the work, so well started by my predecessors, upon conservative lines which will insure its permanency and result in the greatest good to the Institute:

1. For obvious reasons, our recent great rate of increase of membership cannot continue indefinitely, and our expenditures should, therefore, be gauged to meet this condition.

2. Our local chapters should, if possible, be made to last after the enthusiasm, born of novelty, has worn off, which implies encouragement from headquarters and sustained effort on the part of the local members.

3. The work of our special committees in connection with electrical engineering standardization and the collection of technical data should be encouraged, and additional committees appointed to extend the work in other promising directions.

4. We should allow the authors of papers more time for presenting them, and our members more time for their discussion, even, if to accomplish this, we are compelled to have fewer papers.

5. Contributions making provision for our interest in the land for the Engineering Building should be placed in a separate fund, which should be set apart from all other Institute funds, and to which should be credited all funds for building purposes now on hand, and subsequently received for such purposes, from donations or from the sale of bonds or other securities.

6. Our library fund should also be carried as a distinct fund, and all donations and appropriations for library purposes credited to it; all expenditures for library purposes to be debited to this fund.

7. On account of the International Electrical Congress to be held at St. Louis in 1904, we shall be called upon not only to contribute to the scientific value of this Congress, but to receive and entertain many distinguished guests and members from foreign countries. Our plans should, therefore, be so well and broadly laid and executed that our guests shall return home not only fully repaid for their visit among us, but shall also feel that the splendid hospitality which was shown us as a body on our trip abroad in 1900, and to our individual members before and since, has been fully appreciated.

8. Our relations with the other large engineering societies of this country have, during the past year, become more intimate, and we are now about to join with them in the ownership and membership of a union engineering building, which shall meet the ends of all. The general preliminaries have been perfected, and the work of the coming year will consist in the crystalization of the plans and the originating of definite means and methods for raising funds and for promoting the material progress of the work.

I trust we may be able to carry to a successful conclusion the work so splendidly initiated by my predecessor, Mr. Scott, and his able lieutenants, and in such a manner as not only to retain but to heighten the respect and good will of those who may co-operate with us; and by the adoption of rational methods and the exercise of good business judgment in carrying on the work, insure that the generous gift of Mr. Carnegie to the engineering profession shall be ideally, and in its material culmination, all that he hoped it would be.

I wish to express my appreciation of the confidence you have shown in me by placing me at the head of this Institute, the youngest, yet one of the most progressive, of the several great engineering bodies of this country. I sincerely thank you, and I feel that you will accord me such harmony of action and support that the coming year may be of the greatest benefit to our membership, and add in some slight degree to the prestige of the engineering profession at large.

Electric Moving Platforms for New York City.

The Extensions Committee of the New York Rapid Transit Commission has recommended that approval be given the plan of the Continuous Transportation Syndicate for a moving platform system through a tunnel in New York and then across the Williamsburg Bridge. The moving platform idea is already familiar to our readers, and the present scheme has already been noted in ELECTRICAL WORLD AND ENGINEER.

The tunnel in Manhattan will be divided into two sections by a partition, so that trains will run in but one direction in each. The tube itself will be little larger than those now being constructed for the subway. Electricity will be the motive power.

The wheels are not to be on the cars themselves, but are to be stationary. The rails, instead of the wheels, will "run." There are to be three platforms. A passenger getting aboard would step from the station platform onto the first, which is going one-third as fast as the third, whereon are the seats. Then he would step from the first to the second, going in the same direction, but a third again as fast as the first. From the second he would step to the third and last, which is made up of many short cars so closely joined together that they form a single train, and it would be difficult to see the separate sections. The seats are to be crosswise of the car, as at Chicago in 1893, so that the passenger will always be facing the direction of the motion of the train. They will be about three feet apart, and each will seat three persons comfortably. When a passenger approaches a station at which he wishes to get off, he steps from the third platform to the second, and sees the seat in which he sat speed on ahead. Then he steps to the first and finds himself hardly moving. When the station is reached he alights.

For those who might lose their balance, standards or posts will be fixed at points on all of the platforms as at Paris in 1900; when there were no seats provided.

The seats, being three feet apart and holding three passengers, will mean one passenger for each lineal foot. When the platforms are moving at, say, nine miles an hour, and that is a fair average and one perfectly possible, the line could carry 47,520 an hour—nine times the 5,280 passengers in the mile.

In the present plans for the tunnel and trains it is the purpose to use nothing inflammable except the wooden backs of the seats; and steel may be substituted for the wood there when it comes to the construction. The dynamos and all of the wires are separated from the passenger tunnel by a thick wall of concrete.

A modern system of artificial ventilation will be installed which will provide fresh air for the tube, and, in case of the burning of a wire or dynamo, the offensive odors would be carried out of the tunnel immediately. The lighting plant will be separate from the motive power, so that an accident to one would not affect the other. Along the side of the tunnel, below the platforms, and on a level with the dynamos will extend a small passageway for inspectors, who will be on watch all the time for trouble. The wheels and all of the machinery are to be reached from below, so that repairs can be made without interference with the platforms or passengers.

The stations will be similar to those being built for the subway, with guards to give any aid required. No attendants on the trains would be necessary. The fare, it has been tentatively determined will be 3 cents for a single ticket and 5 cents for two.

It is expected to complete the line from Battery Park across the Williamsburg Bridge in about two years, although it may be done in less time. The first section of the tunnel will extend from the bridge to a convenient point a short distance from there, perhaps at the Bowery, which the engineer thinks could be in operation within a year after the work was begun. At the next meeting of the Board of Estimate and Apportionment, it is understood, it will be decided what portion of the new bridge the moving platforms shall occupy.

A Suggested Hydraulic Unit.

At the September meeting of the American Institute of Electrical Engineers, Mr. Ralph L. Montagu suggested the creation of a new unit for the measurement of water power. There is at present in use on the slope a unit of measurement of the flow of water known as the "Miner's Inch." The legal definition of the means of measuring this volume varies so much in different States that the actual flow of legal miners' inches is from 1.36 to 1.73 cu. ft. of water per minute. For this reason a miner's inch unless the cubic feet flow per minute that it represents is specified, can be dispensed with. On the other hand formulæ relating to horse-power of water are based on the number of cubic feet of water per minute, or gallons, under a certain head; that is, the vertical distance of fall. Mr. Montagu suggested that a new unit composed of one cubic foot of water per minute under one foot head be recognized and a name for it suggested by the Institute. This unit would equal 62.3808 ft. lbs., or .00189 hp, or 1.40994 watts.

An analogy can be drawn between this unit and the watt, inasmuch as the head in one is similar to volts in the other, and the cubic feet of water per minute takes the place of amperes in the other. The following formula for horse-power of water is based on this unit or its equivalent value, viz., .00189 hp.

$$\text{Horse-power} = \frac{\textit{Cubic feet of water per minute} \times \textit{head in feet}}{K} \quad (1)$$

$$K \text{ for any efficiency } x = \frac{52900.8}{x} \quad (2)$$

Mr. Montagu gave the following example of the use of the proposed unit:

A water power consists of a flow of 3,700 cu. ft. of water per minute, with a total available head of 763 ft. There are the following losses due to friction resistance, etc., viz.:

5 per cent. loss of head from friction in pipe line.
15 per cent. in prime motor.
3 per cent. in generator.
3 per cent. in step-up transformers.
10 per cent. in transmission line.
3 per cent. in step-down transformers.
2 per cent. in low-tension wiring.
6 per cent. in motors.

Required total horse-power available at motor pulleys:

Total efficiency $= 100 \times .995 \times .85 \times .97 \times .97 \times .90 \times .97 \times .98 \times .94 = 63.12$.

$$K = \frac{52900.8}{63.12} = 838 \quad (2)$$

$$\text{horse-power} = \frac{3700 \times 763}{838} = 3368 \text{ hp available at motor pulleys.} \quad (1)$$

The following table gives values of K, based upon water of specific gravity of 1, one cubic foot of water weighing 62.3808 pounds:

% Efficiency.	K.	% Efficiency.	K.	% Efficiency.	K.
94	562	79	669	64	826
93	568	78	678	63	839
92	575	77	687	62	853
91	581	76	696	61	867
90	587	75	705	60	881
89	594	74	714	59	897
88	601	73	724	58	912
87	608	72	734	57	928
86	615	71	745	56	944
85	622	70	755	55	961
84	629	69	766	54	979
83	637	68	777	53	998
82	645	67	789	52	1017
81	653	66	801	51	1037
80	661	65	813	50	1058

In discussion of Mr. Montagu's paper, Mr. C. O. Mailloux said he considered that the author has performed a service, not so much in suggesting the adoption of a new unit of measurement, but rather because he brings forward quite forcibly an additional good reason why we should adopt and use the metric system. Proceeding, he said that if we think of this matter in metric units, we will see at once how simple it becomes, and we find that, in reality we do not need to complicate the unit system and burden it by additional names. According to the metric system a cubic meter of pure water (or, for practical purposes, clean water), weighs 1,000 kgm. or a "metric ton," while a cubic decimetre of water, being the thousandth part of a cubic metre, weighs exactly 1 kgm. We also find that 75 kgm-metres per second equal one "metric" horse-power, while 76 kgm-metres per second equal one "English" or "American" horse-power (33,000 ft. lbs. per minute, or 550 ft. lbs. per second). With these data we have all that is necessary to enable us to make readily and quickly any calculations whatever relating to water power. We have our horse-power unit already, and as it is the same for water power as for steam power, namely, 75 kgm-metres per second. We take the volume of water flowing, in cubic metres per second, multiplied by the height through which it falls in metres, and we have kilogram-metres per second direct; and if we divide that product by 75, we have the result at once in metric horse-power. If we divide it by 76 we have the result in standard American horse-powers, each equal to 33,000 ft. lbs. per minute. Again, let us remember that the kilowatt is, in round numbers, a little over one-third of one horse-power, or 76 kgm-metres per second, for English horse-power units (1.34 times greater to be exact), also not far from one-third of 75 kgm-metres per second for metric horse-power units (1.358 times greater to be exact). We then see that the kilowatt is equivalent, in round numbers, to 100 kgm-metres per second. (To be exact, it is equivalent to 101.8 kgm-metres per second. Nothing could be easier to remember and to apply. It seems that if the committee of French savants appointed at the time of the French revolution, or over 110 years ago, to work out this question, had sought to devise a system intended to be of special use to water power measurements, they could scarcely have done it more successfully. We have here another of the many ways in which the metric system shows its adaptability to various purposes, and its superiority to all other systems.

In conclusion, Mr. Mailloux said that aside from the possible (he was going to say doubtful) value and utility of the present paper in proposing a substitute for and an improvement upon the "miner's inch" to miners in the West who are accustomed to the old nomenclature, its greatest utility is in the lesson which it contains to the effect that we cannot too soon abandon the old-fashioned system of measurement and adopt the metric system, where there is a well-known definite, rational relation between the specific gravity of water, and measurements of length, area and volume. Instead of trying to patch up the antiquated system with another "unit" which, at best, would be only a name for a string of figures, why not do the more sensible thing of adopting a system which obviates altogether the necessity for any like unit? The remarks of Mr. Mailloux were received with much applause.

New York State Street Railway Convention.

The twenty-first annual convention of the New York Street Railway Association will be held at the Yates House, Syracuse, on October 6 and 7. The executive committee is very desirous to have a large attendance, and has requested the announcement to be made that supply men are particularly invited and will be rendered a cordial welcome. There will be space provided for small exhibits in the writing room and rotunda of the Yates Hotel. Applications for space should be addressed, with full particulars, to Philip J. Honold, care Syracuse Rapid Transit Company, Syracuse, N. Y. The Syracuse Rapid Transit Company has made a number of improvements in its system during the past two or three years, so that the engineer will find a great deal to interest and instruct him in a study of the street railway system.

The general programme of entertainment of the convention delegates has been drawn up under the direction of Mr. Connette, the general manager of the Rapid Transit Company, and is a most attractive one. It includes trolley rides and luncheon for the ladies; tally-ho ride to the Onondaga Indian Reservation and Green Lake Park; the annual dinner, which will be held at the Yates House; a trolley ride to Edward's Falls, for the ladies; a trip to Skaneateles and a Bohemian luncheon and dancing at Long Branch.

As soon as the guests arrive at the hotel and register, a badge will be supplied by the Association, which will entitle the wearer to free transportation during the convention on the lines of the Syracuse Rapid Transit Railway Company, the Auburn & Syracuse Electric Railway Company, the Syracuse, Lakeside & Baldwinsville Railway Company and the Syracuse & Suburban Railroad Company.

New Telephone Patents.

NEW TYPE TELEPHONE LOCK.

Many telephone locks have been patented during the last year or two embracing more and more simple coin-controlled hook switch locks. These locks have all been adapted to be so mounted that their bolts would secure the hook switch in the depressed position until the deposit of the required coin. All have had the same defect, namely, that in case the hook switch, once released, is depressed either accidentally or for the purpose of calling the operator, the bolt at once secures it until a second coin is deposited. Mr. W. H. Scott, of St. Louis, has, therefore, departed from this type of lock, transferring the control from that of the switch lever to that of the receiver itself. To this end a star wheel is arranged partially within and partially without the lock case. This star wheel will take the small end of a receiver between its teeth and when the lock is so mounted that the exposed star wheel teeth when in the locked position are at right angles to the hook switch prongs, the receiver may be secured from removal from the hook. When the star wheel is released the removal of the receiver for calling or conversation is accompanied by a rotation of this wheel. The means for securing the star wheel against rotation is a latch which is adapted to be raised by the deposit of a coin or by auxiliary electromagnetic devices under the immediate control of the owner of the premises where the telephone is located. The lock is so designed that it is impossible to place the receiver upon the hook without its making proper engagement with the star wheel, and lest the receiver be accidentally locked off the hook, the latch is single-acting, securing the star wheel against forward rotation only. Mr. Scott's patent has been assigned to the Controller Company of America.

A MEMBRANOUS DIAPHRAGM TRANSMITTER.

Few persons expect to see transmitters with membranous diaphragms patented at this late date, yet such a transmitter is the subject of a patent issued to Dennis O'Brien, of Limestone, N. Y. This transmitter is truly of a freak type, as it is designed as a microphonic magneto-multiplying transmitting combination. It is also suggested by Mr. O'Brien as a repeater. A sectional view of the apparatus is shown in Fig. 1. Over an insulating frame is stretched a rubber

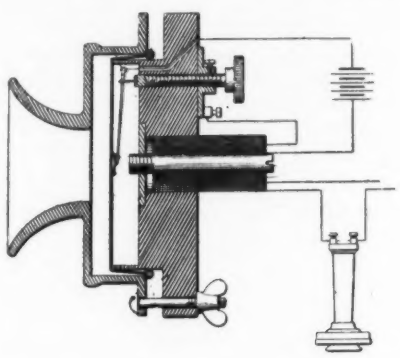


FIG. 1.—O'BRIEN TRANSMITTER.

membrane diaphragm with its edges held beneath an adjustable strain ring forming part of the mouthpiece. To the center of the diaphragm a disc of ferrotype metal is attached, forming a movable armature for the induction coil core secured immediately beneath. Resting against the ferrotype disc is the end of a lever, which is fulcrumed at its farther end, and which is threaded through the eye of a short needle. The needle rests in the cup of the adjusting thumbscrew. The fulcrum, needle eye and cup contacts form the microphonic contacts, these several parts being oxidized "to increase their microphonic power." The primary induction coil circuit includes these contacts, while the secondary passes to the line. The motion of the ferrotype disc affects the secondary circuit by direct magnetic influence and also by varying the primary resistance through the microphone. Furthermore, as these two effects are interdependent, a multiplying of some sort should take place, but exactly what this multiplying will result in is certainly hard to predict in the absence of an actual test.

INSTRUMENT NOVELTIES.

A peculiar arrangement of subscriber set is the subject of a patent granted to M. S. Voight and assigned to the Voight-Berger Company. The talking instruments are of the hand microphone type and are attached to a long cord. This cord issues from a magnetic case passing through a weighted idler and thence over a pulley secured by a ratchet device to the magneto drive shaft. When the hand microphone is drawn toward the user, the passage of the cord over the pulley drives the generator to signal central.

A very compact arrangement of subscriber's wall set is the invention of W. Kaisling, of Chicago. Fig. 2 shows a view of the backboard, with the cover box turned down. A metallic bridge spanning the condenser carries the induction coil, terminal block,

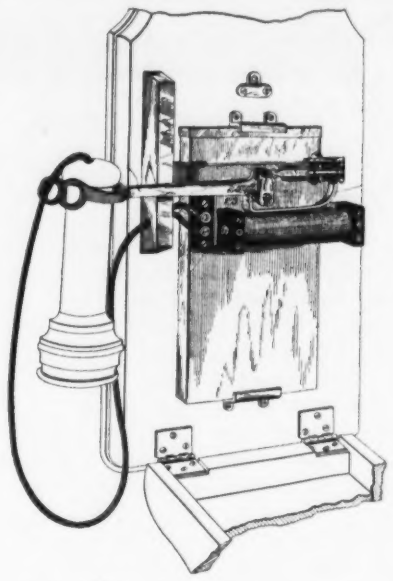


FIG. 2.—KAISLING TELEPHONE SET.

hook switch springs and a stud for the hook switch. This stud riveted in the bridge is provided with an annular groove into which a slotted locking plate can slide to lock the lever in the stud. The locking plate in turn is secured in position by a shoulder of the screw which serves as an arbor for the spring actuating roller.

Mr. Kaisling has also obtained a patent for a receiver cord tip. This tip is in two parts, the outer being the tip proper, while the inner is a sheet metal bushing formed up about the end of the conducting cord strand in a manner such that not only does it hold the wires together, but it also secures the braiding from fraying within the end of the tip. Mr. Kaisling has assigned both his patents, the first to the Stromberg-Carlson Company and the second to the Kellogg Company.

A substitute for the secondary cut-out button is a transmitter diaphragm damping device and is patented in the shape of a push button in the transmitter face, which may be pressed against the diaphragm. It is of very doubtful utility, however. The patent for this device is granted to H. D. Stroud, of Chicago.

The receiver holder again appears in a patent issued to E. J. Murphy, of Crandall, Tenn. This seems to have no advantages over, but retains all the defects of, its predecessors.

LIGHTNING ARRESTERS.

Three protecting devices for telephones which have recently been patented are a thermal cut-out invented by G. E. Hoglund, of Chicago—a carbon plate arrester, the work of John Davis, of Sterling, Ill., and a line opener by B. W. Holdridge, of Trenton, Mo. Mr. Hoglund's heat coil is wound upon an insulator having a reduced section. When the coil heats the insulator softens and is pulled apart by the tension of the spring terminals. As the terminals part, the coil end is separated from one terminal by the spring tension. The invention in the carbon plate device lies in serrating the lower carbon to facilitate the falling of dust from between the ground and line elements after a discharge. The line opener is a device having the general appearance of a large safety pin. The end of the line wire is looped and passed over the pin point and normally clasped within the pin. The retaining hook of the pin is rotatable about its longitudinal axis, and is under the control of the operator through a string passing to his premises. When a storm arises a pull on the spring releases the pin which action causes the line wire to fall to earth.

CONTACT RELAY.

A contact relay was discussed some months since in these columns in which adjustment for operating limits was secured by varying the air-gap of the magnetic circuit without varying the position of the armature. In this relay a screw pole extension was arranged in the end of the core. This screw adjustment has now been transferred from the core to the armature itself, at the hands of C. M. Hedman. Fig. 3 shows a sectional view of the relay, which is self-explanatory.

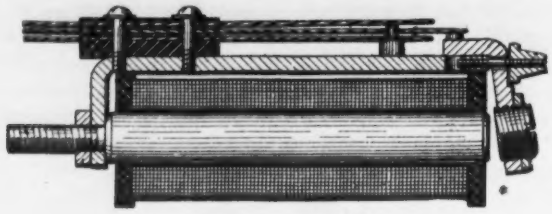


FIG. 3.—HEDMAN CONTACT RELAY.

A CRUDE SWITCHBOARD CIRCUIT.

Most all switchboard circuit inventors are working toward a simplification of the common battery switchboard. The latest patent for a simplified system is that granted to S. A. Duvall, of Chicago. This is a two-wire jack system in which, while separate talking and signalling batteries are used, a cut-off relay is dispensed with. Unfortunately, the circuit shown in the patents seems to be inoperative, as the line signal relay is cut out by short-circuiting, its operating battery being thereby placed directly across the line. This, of course, effectively short-circuits the line to talking currents.

SELF-TYING INSULATORS.

Two types of self-tying insulators are shown in Fig. 4. The right-hand one, in which the line wire is to be fed by a twisting motion through curve slots into a transverse aperture, is the invention of W. G. Rutledge, while the second, with the screw cap, is patented by H. Bottjer.

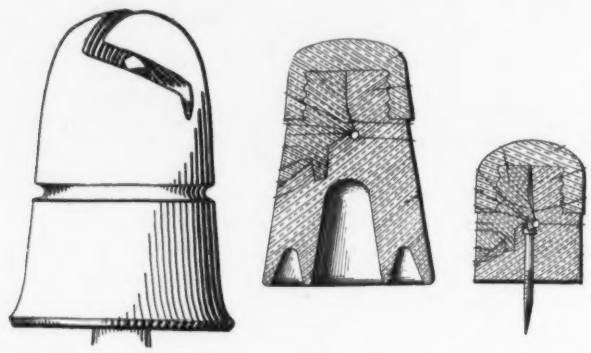


FIG. 4.—RUTLEDGE INSULATOR.

SELECTIVE SIGNALLING POLE CHANGER.

The final patent at hand for consideration is that for pole changer granted to T. W. Warner, of Muncie, Ind., and assigned to the Warner Electric Company. This pole changer requires an operating and a ringing battery. The first keeps the switch arm vibrating continuously, while the second, connected to the arm and various switch springs between which the arm vibrates, sends out independent circuits, positive impulses, negative impulses and alternating impulses.

British Trolley Commission.

The Royal Railroad Commission appointed to study the American street railway systems with a view toward bettering the conditions in Great Britain, arrived in New York on Saturday last on the White Star line steamship *Arabic*. The commission consists of Sir David Barbour, K. C. M. G.; George S. Gibb, director and general manager of the Northeastern Railroad; Lord Ribblesdale, and Sir John Dickson-Poynder, Bart., M. P. No definite plan has been determined upon for the commission to follow out, but an investigation will be made of every branch of American street railroading. Three weeks will be spent in New York and Boston. Hearings will begin in New York this week.

Latest Bell Telephone Statistics.

The American Telephone & Telegraph Company has lately issued $22,000,000, the subscriptions upon which became due last week, and are understood to have been fully taken up. The company has filed the subjoined report with the New York Stock Exchange:

The American Telephone & Telegraph Company requests the admission to the regular list of the New York Stock Exchange of 219,432 additional shares of its capital stock offered to its stockholders, and of 70 shares withheld from previous applications. The authorized capital stock of the company is $250,000,000. Its issued capital stock is now $136,826,600, of which amount the listing has been authorized of $109,702,200; $56,900 of that offered in 1902 have not yet been issued; $27,117,400 are held by the American Bell Telephone Company. In our application of June 18, 1903, it was stated that 271,244 shares were held by the American Bell Telephone Company, of which that company has since that date exchanged 70 shares for shares of its own stock. Application is now made for the listing of these 70 shares as above stated.

In addition to the amount of capital stock above named as now issued, the company has in a circular to its stockholders, dated June 15, 1903, offered for subscription 219,432 shares of stock ($21,943,200), to be issued in October, 1903, or in May, 1904, and the application hereby made is for the listing of these additional shares from time to time as and when issued. The issue of these additional shares has been authorized to provide funds for the general purposes for which the company was organized, namely: Constructing, buying, owning, leasing or otherwise obtaining lines of electric telegraph, partly within and partly beyond the State of New York, and of equipping, operating or otherwise maintaining the same.

An estimate of the disposition of the proceeds of this issue of stock is as follows:

For the New England States	$1,535,900
For the Middle States	6,603,000
For Canada	500,000
For the Middle Western States	2,520,000
For the Western States	1,458,450
For the Southern and Gulf States	2,709,200
For the Pacific States	501,000
For the purchase of instruments, etc., and for the construction of long distance lines	4,250,000

Following are statements of resources and liabilities of the company June 30, 1903, and of earnings and expenses January 1 to June 30, 1903:

Resources:	
Construction, equipment and supplies	$24,491,923
Telephones	7,072,205
Real estate	1,836,029
Stocks and bonds	125,538,075
Patent account	173,715
Machinery and tools	48,126
Cash and deposits	7,246,185
Bills and accounts receivable	16,762,615
American Bell Telephone Company	22,110,401
	$205,279,274
Liabilities:	
Capital stock	$136,826,600
Capital stock installments	9,620
Surplus	3,764,021
Bonds	28,000,000
Reserves	8,543,381
Accounts payable	8,427,052
Income	1,063,390
Contingent	18,645,210
	$205,279,274
Earning (six months):	
Dividends	$3,868,892
Rental of construction	1,469,519
Telephone traffic	2,398,875
Real estate	35,151
	$7,772,437
Expenses (six months):	
Expenses of administration	$477,425
Legal expenses	54,475
Interest and taxes	677,952
Telephone traffic	1,384,837
Net revenue	5,177,747
	$7,772,437

CURRENT NEWS AND NOTES.

PORTO RICO.—Press dispatches from Ponce, Porto Rico, state that during an electric storm on September 28, accompanied by heavy rains, the circuits of the two electric light plants in that city were burned out.

FIRE IN BROOKLYN POWER HOUSE.—On Saturday afternoon last fire in the Fifty-second Street power house of the Brooklyn Rapid Transit Company caused damage to the extent of $6,700, according to official figures. The first reports of the fire were to the effect that the power house was destroyed, entailing a loss of $175,000. The damage was confined to the switchboard. The machinery escaped damage. Service on the street railway lines supplied with power from that station was suspended for some time.

TEACHERS AS CAR DRIVERS.—There are eight township schools in Ohio that have not been opened this fall, and cannot be opened until teachers are secured. There is a dearth of teachers, due to the fact that the salaries paid are considered insufficient. It is said that many teachers in the rural districts have deserted the country and gone to the cities to take places as motormen and conductors on the street railway because the pay is better. A. B. Graham, superintendent of the township schools, said the trouble is due largely to the fact that the poorest workman on the streets receives as much on an average as the country teacher.

WIRELESS ON LARGE TUGS.—On account of frequent trouble due to the breaking away of barges from tows, one of the large Boston towing companies has decided to equip one of its tugs with a wireless telegraph system, and two topmasts and the necessary rigging will be ready for the vessel when she next comes to port. With tugs having on board such equipment, it will be possible, in case of an accident at sea, to notify the agents of the fact and obtain assistance within a short time. In the recent gale on the New England coast when the steamer *Charles F. Mayer* lost a barge, it is claimed that the barge could have been saved had the steamer been able to communicate with the shore. Wireless stations are now so frequent along the shore that tugs will be within range of some one of them all the way from the capes of the Chesapeake to Boston.

TO CLOSE COLOMBIAN CABLE. It is announced that the cable service to Buena Ventura will be closed at the end of September. The inspector of Telegraphs has received orders from Bogota to close the Central and South American Company's office at the seaboard on the suspension of the service to Buena Ventura. If the Colombian Government carries out its threat the company will lose heavily. The Government in the meantime is making efforts to establish the Marconi system of wireless telegraphy between Panama, Chiriqui, Buena Ventura, Colon, Bocas del Toro and Cartagena. It is also reported that the West India and Panama Telegraph Company will offer to construct a cable to Buena Ventura. The Colombian Minister of State has made public the demands of the cable company, which asks for a new concession lasting twenty years and the privilege of raising the tariff. Among the reasons given for the Government's refusal of these propositions is that an Italian company has applied to establish a system of wireless telegraphy.

WATER POWER IN ALASKA.—It is stated that several prominent operators at Cape Nome are developing a project to supply all of Seward Peninsula with electric and water power for hydraulic mining on a mammoth scale. East of Port Clarence, within a few miles of salt water, rise the Saw Tooth Mountains, from the heart of which gush forth several mountain streams. It is proposed to harness these rivers and generate an aggregate of near 100,000 horse-power, using the water-power for generating current, which will be transmitted to Nome and all other mining districts of Seward Peninsula. The current will then be utilized in lifting water from various rivers and creeks for hydraulic mining purposes. At present, steam plants are being used, but the cost of machinery and fuel is so great that they can be employed only where the ground is very rich. Two engineering parties are in the field surveying the falls and rivers of the Saw Tooth Mountains. With ample volumes of water, which can be found nowhere else on Seward Peninsula, and with a fall of 700 to 1,800 feet, enormous power can be obtained. The Saw Tooth Power and Mining Company is being organized to develop it. It is intended to get a portion of the machinery installed next summer.

WATER POWER IN THE PHILIPPINES.—A number of firms in Manila have petitioned the Philippine government for franchises to develop water power in those islands. According to a Washington dispatch, Gov. Taft is now having surveys made of the Botocan Falls and two other falls in the province of Laguna, within 55 miles of Manila. The investigation already conducted warrants the belief that about 10,000 horse-power can be secured at these falls, and no engineering difficulties are presented. Applications have also been received for a franchise to develop the power of the Angat River in the province of Bulucan, where, it is believed, 4,000 horse-power can be secured. The franchises, it is stated, will be let to the highest bidder, after advertising in the United States. The terms will be fixed by the Philippine government, and the government will provide for the sale of power on equal terms to any one who desires it, and the price will be fixed by the Philippine government according to the cost of the operation of the power plants.

ODD DAMAGE CLAIMS.—The managers of street railway systems seem peculiarly liable to queer damage claims, to say nothing of the fraudulent ones. The officials of the Middlesex and Somerset Traction Company, which operates the principal trolley lines in Central New Jersey, believe that there is an epidemic of damage claiming developing around them. Almost every mail brings claims for all kinds of alleged grievances. If a woman gets her dress dusty while riding on a car, the next mail brings a demand for $50 for a new dress. Several days ago a man was jarred by the sudden stopping of the car and dropped his false teeth on the footboard. He claimed damages. Here is a sample of the claims that are filed against the company: "I was on a trolley car that left New Brunswick about 7.30 P. M. Sunday, September 13, 1903. While passing through Sayreville, a short distance from the siding, I was struck in the face by a piece of watermelon thrown by parties along the track, ruining my clothes. I hereby make a claim for same in the amount of $20, and for the assault $100. Please forward check for same."

FIRE IN KANSAS CITY TELEPHONE EXCHANGE. On September 16 fire occurred in the five-story building of the Missouri & Kansas Telephone Company at the corner of Sixth and Wyandotte Streets, Kansas City, Mo., severely damaging the toll board and the main switchboard. It is stated, however, that the greater part of the big "A" switchboard on the fourth floor can probably be saved, although it was drenched. It is thought that when it is dried out it will be available for re-use. Both ends of the board were damaged. It is proposed to dry out the board by using gas stoves to generate the heat for the drying process. The terminal room of this board on the fourth floor was a total wreck, the damage being wrought by water. The company has set up a temporary "B" board, which it will use for toll service, and some old sections of discarded boards have been pressed into service in the emergency. A large force of men from the Western Electric Company's factory in Chicago is at work, and it is stated that it will require about thirty days before the company can re-establish its service on a satisfactory basis. It is making every endeavor to give the public as good service as possible under the circumstances.

ISLES OF SAFETY.—Two more electroliers and isles of safety similar to that recently illustrated and described in these pages, at Fifth Avenue and Twenty-third Street, New York, are to be set up at the intersection of Forty-fourth and Forty-fifth Streets and Longacre Square, between the tracks of the street railway lines converging there. The electroliers will be the gift of a person who withholds his name and makes the Municipal Art Society his agents. The donor will bear all expense of building and placing, but the lighting and care of the structures once completed will fall to the city. Borough President Jacob A. Cantor has consented to take all steps necessary to carry out the donor's wishes, and the Committee on Street Fixtures has reported favorably on the sites selected. The electroliers, standing some 20 ft. high and made of ornamental bronze by the Gorham Manufacturing Company, will be crowned with a pyramid of four white light globes surmounting a triangular street sign. The design is that of H. Wallin, who received the second prize in a contest last year under the auspices of the Municipal Art Society, the giver of the electrolier at Fifth Avenue and Twenty-third Street. Secretary William S. Crandall, of the society, has secured the necessary permits, and work will begin at once.

LETTER TO THE EDITORS.

Tangential Traction.

To the Editors of Electrical World and Engineer:

SIRS:—The three-phase system attributed to Signor Guarini on page 530 of your issue of September 26, and previously described in a general way by you, was patented in this country about ten years ago by Mr. E. E. Ries, in all its essential features, so far as the description in your paper goes.

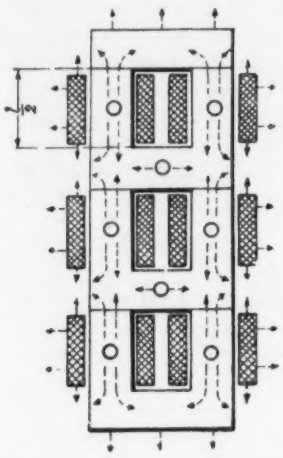
None of these conditions of opening out the stator in plane seem to regard the magnetizing current in the idle sections as of any importance at all. It would be interesting to know what the wattless current would be in such a system as the one outlined.

NEW YORK CITY. T. J. JOHNSTON.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

New Type of Polyphase Transformer.—ZIEHL.—An article in which the author describes a construction differing from the usual arrangement, which is to have the three cores of a three-phase transformer in one plane or at the angles of an equilateral triangle, with two yoke pieces in common to all three. As shown in the accompanying figure, the new arrangement consists in the superposition of two or more cores, each forming a closed magnetic circuit. The author states that this construction has the advantage of considerably simplifying the manufacture, inasmuch as for single, two and three-phase transformers equal cross-sections for the iron sheets, equal patterns for the magnet coils and equal armature parts, can be used. Comparing three individual transformers with a three-pole transformer of the new construction, the latter shows under otherwise equal conditions a considerably reduced weight of iron, inasmuch as the number of iron yoke pieces is only 6 instead of 8. With the same magnetization the losses are, therefore, diminished. Also, when the heat radiation of the new type is compared with that of the three-core type, it is found that the former has a considerably larger cooling surface, and a considerably greater capacity to dissipate the heat. The difference between the maximum inner and outer temperature of the iron will be about one-quarter of that in the old construction, which means that the maximum induction in the new type can be chosen higher. The case is similar with the coils, and another advantage in this connection is the division of the copper coils into as many parts as possible, thus getting a large cooling surface. From the possibility of a higher magnetism of the iron and a larger cooling surface, there results naturally the possibility of a higher current density in the copper, and therefore saving in copper and iron. An influence of the magnetic fluxes upon each other cannot take place as the middle yoke pieces, between two phases, bring about an equalization of a one-sided load, because an excess of lines of force of one phase cannot enter into another phase-winding, but has to travel through the intervening yoke piece. The loss of potential from no load to full load, caused by the leakage and the ohmic loss, has with equal load on the phases, the same percentage value in each of them, because, apart from the ohmic loss, the lines of leakage or the leakage potentials, which appear on short circuit of the transformer, are equal in each phase. The leakage potentials themselves only reach very small amounts on account of the compact construction; that is, the smaller leakage surfaces and the longer leakage-line paths. Therefore the total loss of potential of the transformer is very small. A transformer is illustrated of 25 kw capacity, running at 2200/210 volts and 50 cycles, which had a total weight of 345 kilograms, including the oil, of which weight 59 kilograms were for copper and 116.5 kilograms for the iron sheets.—*Elek. Zeit.*, September 10.



POLYPHASE TRANSFORMER.

Theory and Working of Rotary Converters.—ROGERS.—An article in which the author reviews the working of the rotary converter, and more especially the three-phase type. He discusses the different methods of excitation and regulation, and dwells at some length on the starting and parallel running of converters. He states as advantages of the rotary converter: 1, a large overload capacity; 2, high efficiency; 3, relatively low cost and high power factor. In comparing the cost of rotary converters with other forms of transforming machinery, it must not be forgotten that step-down transformers must be provided, which increase the cost and lower the efficiency of transformation. The disadvantages of the converter are stated as follows: 1, sensitiveness in parallel running; 2, necessity of using complicated regulating apparatus and switch gear; 3, requirement of skilled attendance; 4, necessity of operating by currents of low frequency to obtain satisfactory working, which currents are undesirable for use in other forms of transforming apparatus, so far as economy of copper is concerned. Notwithstanding these disadvantages, however, the author believes that the rotary converter will continue to play a very important part in the working of the large power schemes in connection with electric traction and the supply of electrical energy in bulk. —*Lond. Elec.*, September 11.

Armature Reaction in Alternating-Current Machinery.—THORNTON.—An article, accompanied by diagrams, in which the author discusses some effects of the armature reaction in alternating-current machinery. He notes that the influence of mechanical inaccuracy of construction is small compared with the effect of the armature reaction. When examined with an oscillograph, both exciting current and generated voltage are found to exhibit well-marked ripples, which in the case of single-phase converters, are large enough to profoundly disturb the direct-current output. The author carried out experiments with two bipolar ring-wound, direct-current generators, with solid rectangular cores and yokes, fitted with slip rings so that they could be used as single, two or three-phase generators, synchronous motors or converters. This made it possible to compare the same machine working under identical conditions of load and excitation, but with different kinds of alternating current in the armature. The second machine received alternating current from the first, and its current was conducted to storage cells or an equivalent liquid resistance. The diagrams obtained by the author show, that the general disturbance is much greater in single-phase than in three-phase working. The amplitude of the single-phase ripple in the charging current is about four times as great as the three-phase. The chief interest of the curves is that everything seems to be in a state of quiver, armature currents, field currents and voltages, in order of relative intensity. The author states that it might be expected that a continuous component in the first machine would steady the system, and it does, when this is a double-current generator; but as a converter it is almost as unsteady as when a single or three-phase generator alone. A table of variations of current and voltage caused by armature reaction, expressed in percentage of the average values of each, is given, from which it appears, that in general the second machine has the greater disturbances of continuous armature current, more than double the variation in the first when single-phase. The voltages and field currents have ripples fairly constant in magnitude, whether charging cells or on ohmic resistance. The most pronounced effect is in the change from cells to resistance. With two converters the ratio of percentage current disturbance is 80/33, *i. e.*, 3.4; but with generator and converter it is 93/22.5, *i. e.* 4.1. The three-phase disturbances are much less, and for converters the variation is less with cells than with liquid resistance. So far as the power factor of the continuous-current output depends on field variation, the phase of the ripple in the field with regard to that in the cell current, is important,

for it is the cosine of the angle between the generated voltage in the machine, which depends on the instantaneous state of the field, and the armature current, that is the observed power factor. The stiffer the field of the second machine, the less the power factor of the continuous current should be and is. Short-circuiting the series coils on the first machine altered the phase of the field-current disturbance by nearly 90 degrees more into phase with the ripple in the cell current. The power factor of this was therefore increased, but at the expense of the energy lost in the coil and core, amounting to 1, or even 2, per cent. of the output in extreme cases. A lagging current in the machine strengthens the field, and as the magnitude of the voltages changed when the current from the second machine is switched from cells to resistance, the conclusion is that the internal current lagged more when charging cells. It is this which is most conclusive in determining the cause of the ripples to be the armature reaction. The frequency of the ripples is twice that of the main wave, whether the machine is driven from the alternating or direct side. A more important point bearing on the number of teeth or slots per pole per phase which generators should have for driving three-phase converters, is that in all the three-phase armature currents and voltages, 12 ripples per period are to be observed. The conclusion is that three-phase machines with two slots per pole per phase are unsuitable for driving converters, if it is desired to have a perfectly steady, continuous current supply.—*Lond. Elec.*, September 4.

POWER.

Three-phase Motors for Electrical Driving.—Eborall.—The first part of a paper read before the English Society of Arts. As far as the question of direct current versus three-phase current is concerned, the author is of the opinion that if each case is decided strictly on its own merits, it will be found that a three-phase installation is preferable for most classes of work, on account of its greater simplicity, flexibility and reliability, it being at the same time cheaper to install and to maintain. The three-phase equipment appears to greater advantage in these respects as the severity of the work increases, for a properly laid out three-phase plant possesses a capacity for standing overloading and rough treatment, which certainly cannot be equalled by the corresponding direct-current equipment. It is only when a great amount of economical speed regulation is required that a three-phase system cannot hold its own with direct-current working; the question of economical speed regulation over a wide range is the weak point of the three-phase motor. The author then considers some questions relative to the construction and performance of three-phase motors, dividing them into two classes, viz., those with permanently short-circuited rotors and those with round rotors and slip rings. He states that the three-phase motor with permanently short-circuited rotor is in all respects, except with regard to starting performance, an ideal motor to employ for all work requiring constant speed; for certain classes of work, in which the motor has to work in a more or less inflammable atmosphere, it is the only type of motor that can be used with absolute safety for any purpose. Curves are given showing the running and starting performance of a 10-B-hp, three-phase motor, with permanently short-circuited rotor, specially designed for large starting torques and intermittent working. A motor driving a line of countershafting and having a permanently short-circuited rotor, will take about three times the full-load current at starting. As the power factor of this starting current is usually of the order of 20, with a large motor the drop of pressure over the system may be such as to impair seriously the lighting service, and may even affect other motors. The author then deals with motors, which have to start with full-load or still greater torque, such as crane motors.—*Lond. Elec.*, September 4.

Electrically-Driven Mining Plant.—Hooghwinkel.—The second part of his article previously referred to in the Digest. A brief review of the various constructions of coal cutters is given. The motor should be rated 30 to 40 per cent. higher than the horse-power required. The author found for the average required horse-power the following values: for disk machines, 12 to 18-hp motor rated at 25-B-hp. The performance of several machines in active operation is then described.—*Lond. Elec.*, September 4.

Electric Driving in Workshops.—A note on the equipment of the Queensland Railway shops with electric driving equipment. Power is supplied to the shops by three 200-kw, two-phase generators of 220 volts at 60 cycles, connected to vertical, single-acting compound condensing engines. In all, 161 induction motors are employed, ranging from 1 to 75 hp, aggregating about 1,200 hp. Eleven electric cranes are in operation.—*Lond. Elec.*, September 4.

Power Plant.—An article containing an illustrated description of the power plant of the Rock Island-Lake Shore Terminal station in Chicago. Steam is furnished by five water-tube boilers of 250-hp capacity each, fitted with motor-drive traveling grate stokers. The lump coal is crushed by a motor-driven crusher. The generating sets comprise one 500 and two 250-kw units, consisting of cross-compound, horizontal engines and 250-volt, direct-connected dynamos. Current is distributed on the three-wire, 110-220-volt system—*Eng'ing Record*, September 19.

Measuring the Power of Machine Tools.—Walsh.—The amount of power used by different machine tools is determined by each individual shop for its own classes and conditions of work. In operating machines in groups by motors, allowances have to be made for the friction of the shafting and belting. Modern line shafting, however, is made in the best shops so that friction is reduced to a small figure. A line shaft 200 ft. long and 2½ in. in diameter, with its counter-shafts, can be operated by electric power with about 1½ horse-power. A line shaft driving a group of nine machines consumed in a 15-minute test a maximum of 10.43 horse-power and a minimum of 0.88 horse-power, giving an average of 4.6 horse-power. In this group of machines there were small and large ones, the large ones including a heavy wheel-press of 50 tons, a 72-in. wheel-lathe, an 84-in. boring mill and a 60-in. planer for cutting cast-iron. When a 42-in. lathe wheel and an 84-in. boring mill were belted to the shaft the power on an average was raised to 6.9 horse-power, but this large increase was due to the fact that the two machines were doing work, and the boring and cutting machines consumed nearly as much power in starting up as all the others of the group did when in full operation. In many shops the grouping of machines to be operated by electric power has been so carefully worked out that the maximum shifting of the load of any group is comparatively small. Slotters and planers are grouped together so that the reversals come at certain intervals. The grouping of machines so that they can be operated together or singly by electric power is an important factor; experience has shown that machines which carry about the same load up to a given maximum can best be grouped together, while those which shift the load frequently between wide extremes should be operated either singly or in pairs, or in groups by themselves.—*Amer. Elec.*, September.

Superheater Tests.—A note on the results of some experiments with a given boiler with and without superheating. The gain in power due to superheating was 36.6 per cent. The consumption of steam per electrical hp-hour was 44.9 pounds without, and 31.7 pounds with superheating. The consumption of coal per electrical hp-hour was 7.51 and 5.45 pounds without and with superheating, respectively.—*Lond. Elec.*, September 4.

REFERENCES.

Coal-Cutting Machines with Three-phase Motors.—An illustrated general description of a machine of recent design of the bar type.—*Lond. Elec. Rev.*, September 11.

Modern Electric Cranes.—Bender.—An illustrated description of the construction of a 10-ton crane, driven by three electric motors.—*Elek. Rundschau*, September 1.

Electric Passenger and Goods Elevators.—An illustrated description of elevators built by a London firm.—*London Engin'ing*, August 28.

TRACTION.

Trolley Omnibus.—An illustrated description of the Lombard-Gerin system in Monteban, France. The cars weigh, empty, about 3½ tons, and are driven by two 8-hp motors, one on each rear wheel, at 500 to 550 volts. The speed is from 6 to 8 miles per hour. There are two overhead conductor wires, on which runs the trolley, which is connected to the car by means of a flexible cable. This trolley is a small automobile in itself, and its speed varies with, but is always slightly greater than, that of the car. It therefore always keeps ahead, and takes up the slack automatically. A small three-phase motor is arranged in the trolley, which obtains its current from the direct-current motors of the car, the armature being tapped for this purpose, and provided with three slip rings. The trolley motor thus runs very nearly in synchronism with the car motor. Provision is also made for actuating a small electromagnetic brake to prevent the trolley run-

ning back, as it might do, for instance, if the car stopped when going up hill. The approximate energy required is given as 1,160 watts per car mile, or 290 watts per ton mile, at a maximum gradient of 6 per cent. The cost of the overhead equipment is said to amount to $3,200 per mile, a better way being to put it at between 40 and 50 per cent. more than for the overhead equipment of a tramway doing the same amount of work.—*Lond. Elec. Times,* September 10.

REFERENCE.

New Electric Locomotives.—Brunn.—A series of articles. The present installment contains the illustrated description of an electric locomotive on a iron-ore hauling road in Hungary, run by 300-volt, three-phase current. The motor is a 20-hp, polyphase motor, with 8 poles, running at 6,000 alternations and 800 revolutions per minute. Owing to the special conditions under which it has to work, this locomotive is provided with a specially constructed current collector, which is illustrated and described.—*Zeit. f. Electrotech. u. Maschineribau,* August 16.

Installations, Systems and Appliances.

Municipal Lighting Plant at Tallahassee, Fla.—Poole.—An illustrated description of the municipal electric lighting plant at Tallahassee, Fla. The plant contains a 115-kw, 2,300-volt, two-phase, 60-cycle revolving-field generator with its exciter. All of the incandescent lighting is on one phase, and the arc lights run either all on the opposite phase, or one circuit is placed on each side as the lighting load varies. The street lighting outfit consists of fifty 7½-amp. series-enclosed alternating arc lamps. The incandescent service is from 105-210 three-wire secondaries wherever the business justifies the running of the same; the more scattered customers are on single transformers.—*Amer. Elec.,* September.

Evolution of the Starting Switch.—A. H. M.—The author briefly reviews the principal defects of starting switches, and calls attention to several factors which deserve attention. He lays down the essential requirements of a satisfactory switch as follows: 1, the resistance must be of ample capacity and of lasting material; 2, the contacts and contact-maker must be properly designed, according to the current to be dealt with; 3, automatic release for no voltage must be fitted; 4, when the switches will be handled by inexperienced persons an automatic starting device must be provided.—*Lond. Elec. Eng.,* September 4.

REFERENCES.

Operation of Rotary Converters.—Fernandez.—An illustrated article dealing with the operation and control of rotary converters operating at their normal capacity. The author considers the case of a rotary driven by current from another machine located in a station some miles distant from the receiving machine, and connected to it by suitable transformers, etc., and also considers the case of a rotary driven from a prime mover. —*Amer. Elec.,* September.

Electrical Station Practice.—Radcliffe.—The first article of a serial on the subject, containing a general consideration of the operating conditions of central stations, which are discussed in an elementary manner.—*Electricity,* September 9.

Wires, Wiring and Conduits.

The Choice of High-Tension Insulators.—Knowlton.—An article in which the author points out that however important good material and workmanship may be in regard to the poles, cross-arms, tie wires and pins of a high-tension line, it is imperative that the insulators be designed, built, tested and installed with the utmost skill and care, since the integrity of the line depends upon their adaptation to the service furnished. In the choice of insulators for circuits of 25,000 volts and upward, four essential features in design should be given special attention, viz.: the resistance to puncture, the resistance to arcing to pin or cross-arm, proper distribution of electrostatic strains and low capacity and proper creepage surface. The voltage required to puncture an insulator should be enough greater than the voltage required to arc over from wires to pin under any conditions to insure the insulator against injury in case of abnormal voltage. Where the petticoats flare widely or are short, there is usually less concentration of electrostatic strain on the inner petticoat, and consequently less liability to puncture. Resistance to arcing is chiefly the function of the longest combined air and insulator surface path which the discharge can be forced to take in passing through the wire to the pin or to the cross-arm. With regard to electrostatic strains, the noise and display of an insulator under test may be taken as an indication of its static capacity and effectiveness of material distribution. The point of visible static discharge should be kept at least as high as the full-line voltage, in order that no insulator should be subjected to undue strain. The area of creepage surface should be made as high as is consistent with reasonable design.—*Amer. Elec.,* September.

REFERENCE.

Calculation of Networks of Conductors.—Busset-Schiller.—An article illustrated by diagrams, in which the author develops a graphic method for finding the most favorable position of the junction points for mains and feeders.—*L'Industrie Elec.,* August 25.

Electro-Physics and Magnetism.

Self Electrification of Radium.—Wien.—The author has investigated the self electrification of radium and the intensity of the rays sent out by it. As the positive particles, discovered by Rutherford, are much more strongly absorbed than the negative ones, it ought to be possible by retaining the positive particles in an envelope permeable to the negative ones, to charge the envelope positively, and the amount of this charge ought to furnish a measure for the amount of radiation sent out. The method used by the author and the precautions which had to be taken to get rid of the radium emanation, which interfered with the measurements, are described in detail. The radium bromide used by the author was enclosed in a glass tube, into which a platinum wire was melted, and the electricity collecting inside had to be conducted to the outside by the platinum wire. This tube was suspended by a glass thread in a larger tube, into which a second platinum wire was melted. The author found the current to be of the order of 3×10 to the -12th power, amperes. The radiated masses of the electrons, figured out from this value, give for the positive particles 4.6×10 to the -17th power gram, per second, and for the negative, 2.9×10 to the -20th power. It is therefore totally impossible to determine the radiated masses by weighing. The energy of radiation is, however, not inconsiderable. The latter figures out for the positive electrons, assuming the velocity as 1.65×10 to the 9th power, as 60 ergs per second, and for the negative electrons, with a velocity of 2.5×10 to the 10th power, as 8.7 ergs per second, from 4 milligrams of radium bromide.—*Phys. Zeit.,* September 1.

Hall Effect.—van Aubel.—The author has found that the addition of a larger quantity of bismuth sulphide to metallic bismuth increases the action of the Hall rotation coefficient, and that the latter is especially high with bismuth sulphide. He found, however, that the bismuth which he had used formerly was not entirely pure, and had therefore given too low a value. He calls attention to the difficulty of getting the metal absolutely pure, and to the influence which traces of foreign metals exert on the Hall effect. He finds from his measurements that the Hall rotation-coefficient has the same sign with pure bismuth, with the sulphide of the metal and with mixtures of both. The strength of the phenomenon is so great with pure bismuth sulphide, that the Hall effect can be used for the measurement of strong magnetic fields. He further investigated whether the Hall effect is influenced, when the plate under investigation is brought into a medium, the specific magnetism of which is considerable. He therefore tried a plate consisting of a mixture of bismuth and bismuth sulphide, containing 4.36 parts by weight of sulphur and 95.64 parts of bismuth. This plate was brought into a glass vessel, which was first filled with pure water and then with a concentrated ferric chloride solution, at the same temperature. No difference in the strength of the Hall effect was observed.—*Phys. Zeit.,* September 1.

REFERENCE.

Terrestrial Magnetism and Atmospheric Electricity.—The last issue of this quarterly journal contains the following articles: Sutherland, the curve of the earth's magnetism; Chree, an analysis of the results from the Kew magnetographs on quiet days during the eleven years 1890 to 1900, with a discussion of certain phenomena in the absolute observations; Adolf Schmidt's charts of the earth's magnetic components for 1885; Bauer and Hasard, results of magnetic observations in the United States up to June 30, 1902; Life and Work of Benj. Franklin, etc.—*Terr. Magn. and Atm. Elec.,* June.

Electro-Chemistry and Batteries.

Electrolysis with Smooth and Platinized Platinum Anodes.—Foerster.—A long article in which the author discusses the results of an extended series of researches, made by him and under his direction on the difference of the behavior of smooth and platinized platinum anodes. If no oxygen is evolved at the anode, the difference

in the behavior of both kinds of electrodes is small; with a platinized anode the active surface is larger and therefore the real current density smaller, other things being equal; the anodic voltage in the electrolysis of an alkaline potassium iodide solution is only 0.07 volt higher with a smooth than with a platinized platinum anode. A much greater difference exists between both kinds of anodes when oxygen is developed, two special peculiarities being observed. First, the potential of a platinized anode increased continually during the course of electrolysis, while smooth anodes soon assume a potential which then remains constant. Second, the potential which a smooth platinum anode assumes is considerably (several tenths of a volt) greater than that of a platinized anode. It is certain that there is some change going on in the interior of the platinized anode during electrolysis. It seems that small parts of the anodically generated oxygen are absorbed by the platinum black, and are stored in it at a gradually increasing pressure; the formation of a platinum-oxygen compound may be assumed which is dissolved in the platinum black in steadily increasing concentration. The author applies his results to several cases of practical importance, and discusses especially alkali chloride electrolysis, the formation of hypochlorite and chlorate being dealt with. The conditions of a platinized anode represent nearly the ideal conditions for sodium chloride electrolysis, but leave the question undecided whether this method of working can be used without modification in practice on a large scale, or whether it will be necessary to try and approach these ideal conditions as much as possible by different, and though imperfect, yet practical means. The author then discusses the application of platinized anodes for the electrolysis of sodium sulphite, and for quantitative analysis by constant potential electrolysis; the use of a platinized anode together with a stirring device enables one to shorten the time required for electro-analysis very considerably. The author believes that the use of platinized anodes may prove useful in the investigation of the electrolytic oxidation of organic compounds.—*Electrochem. Ind.*, September.

Single Potentials.—Patten and Mott.—An account of an experimental determination, together with theoretical calculations of the single potentials of the alkali metals, sodium and potassium. The theoretical single potentials and the experimentally determined values agree well with each other. The results strengthen the view that metals which give potentials lower than the theoretical, do so rather because of the formation of a film upon them than because the metal decomposes the solution with the liberation of hydrogen.—*Electrochem. Ind.*, September.

Bleaching Liquors.—W. H. Walker.—After an historical sketch of the production of bleaching solutions, the author discusses the principal conditions which must be fulfilled in an efficient apparatus for the production of hypochlorite by electrolysis of sodium chloride. It is necessary to prevent as much as possible the discharge of the ClO ions at the anode. The reducing action of nascent hydrogen upon the hypochlorite at the cathode must also be counteracted, either by making the cathode small or by adding to the electrolyte hydrates of calcium and magnesium or by adding chromates or sodium resinate. The formation of chlorates must be prevented by keeping the electrolyte at a sufficiently low temperature by means of a cooling device. The author then describes the forms of apparatus in commercial use, the apparatus of Hermite, Kellner, Schuckert, and Haas & Oettel being dealt with. For laundries, bleacheries and textile mills, the author believes electrolytically prepared bleaching liquors have advantages over those made from chloride of lime; the color of the finished goods is purer and more even; the solution penetrates the fibres more easily, giving a color of greater permanence; there is no danger of the deposition of insoluble calcium salts, producing a harsh or rough feel on the goods. The cost of the plant, especially where carbon electrodes are used, is not great when compared with the diaphragm cells, and the labor of repair and operation is much less. For large paper and pulp mills, however, especially those in which caustic soda is used to reduce the wood to fibre, the diaphragm cells seem to have the advantage.—*Electrochem. Ind.*, September.

REFERENCE.

Measuring Electrode Potential.—W. McA. Johnson.—An article illustrating by diagrams in which the author describes the various methods of determining decomposition voltages and electrode potentials. He discusses the simple voltmeter method, the condenser method, and the use of the potentiometer, and describes the connections in direct-reading potentiometers. He then describes the method of determining the decomposition voltage by measuring the current which flows through the cell when the applied e.m.f. is gradually increased; the curve giving the current as a function of the applied e.m.f., shows a very sharp bend at the decomposition point.—*Electrochem. Ind.*, September.

Units, Measurements and Instruments.

Measurement of Power in Alternating-Current Circuits.—Craighill.—The power in alternating-current circuits can be measured in various ways, but none of them is very satisfactory except the one which involves the use of the wattmeter. This is the quickest and most accurate, and no computation is necessary, as in the case of other methods, the watts being read directly from the instrument. The author considers the method of connecting wattmeters in order to measure the power of a single-phase circuit, of a two-phase system with separate circuits, of a two-phase system having a common return for the two circuits, of a three-phase Y or delta-connected system, of balanced two-phase and three-phase circuits, and of a monocyclic circuit.—*Amer. Elec.*, September.

New Books.

The Alternating-Current Transformer. By F. G. Baum. New York: McGraw Publishing Company. 195 pages, 122 illustrations. Price, $1.50.

A work written by so competent and thoughtful a man as Prof. Baum is deserving of our most careful consideration. The little book before us is an elementary treatise on the theory of the transformer, written in a concise and strictly scientific manner, the treatment being carried through both analytically and graphically. The circle diagram is treated briefly, as well as the regulation diagrams of transformers as originated by Mr. Kapp. Some interesting remarks about ageing and testing will be appreciated by the reader, and the chapter on "Circuit Regulators" will be found useful and instructive. We should also be glad to have seen Prof. Baum's own views on electrostatic capacity and on his experience with long-distance lines embodied in this book, as they certainly would have greatly enhanced its value.

The work is, however, open to some criticism. The description of commercial transformers is somewhat meagre, and perhaps not quite up-to-date. In section 61 it is said, in referring to some curves of the properties of annealed sheet transformer iron: "Curves between B (induction) and watts lost per pound of iron at 60 p.p.s. are given. . . . For any other frequency *multiply the losses given in the curves by frequency* 60." As a matter of fact, the total watts lost per pound of iron are not at all directly proportional to the frequency.

In section 50, speaking about methods of cooling transformers, it is stated: "On account of danger to insulation or of ageing of the iron it is necessary to limit the temperature rise to about 50° C. above the surrounding air. . . . The square inches of exposed surface should be more than *twice* the number of watts to be radiated. See Fig. 46." Now, looking at Fig. 46 (taken from Kapp's "Transformers"), we see that "In case without oil," for 50° C. rise the corresponding watts are .16 watt per square inch, or the square inches are 6¼ times greater than the number of watts to be radiated; and "In case with oil," .27 watt correspond to 50° C. rise, or the number of watts are 3.7 times the radiating surface in square inches. Why then are *twice* the watts the minimum that should be allowed for radiating surface in square inches?

Opere Di Galileo Ferraris. Pubblicate per Cura Della Associazione Elettrotecnica Italiana. Vol. I. Milan: Ulrico Hoepli. 492 pages, 52 illustrations. Price, 12 lire.

To all who consider the increase in our knowledge of the phenomena of nature as the stepping stone to improvement and culture, the death of Ferraris has been a most painful disappointment. The Italian Electrical Association has paid a tribute to the memory of Ferraris by publishing his collected papers, of which the first volume is lying before us. The variety of subjects over which the scientific genius of Ferraris has swept is illustrated by the papers on the propagation of electricity in homogeneous bodies, by his paper on the theory of A. G. Bell's telephone, the theory of the Gaulard and Gibbs transformer, the discovery of the rotary field, his papers on vectors and on many other subjects. Ferraris' famous and fundamental

paper on electromagnetic rotations is preceded by a paper on the phase difference in alternating-current circuits, which he used, as is well known, in order to obtain from a single-phase circuit two alternating currents of different phase. These two papers are dated December 4, 1887, and March 18, 1888. Among the remainder of the contents, his paper on the resolution of an oscillating vector into two vectors of one-half the magnitude rotating in opposite directions, is undoubtedly the most interesting and permanent.

An excellent portrait of Ferraris forms the frontispiece of the volume. His best monument is his life-work, and the love and esteem in which he is held by all those who had the good fortune to know, however, slightly, this great man of science, scholar and gentleman.

BOOKS RECEIVED.

Atlante di Macchine e Caldaie. By Salvator Dinaro. Milan: Ulrico Hoepli. 80 pages, 112 illustrations. Price, 3 lire.

The Elasticity and Resistance of the Materials of Engineering. By Wm. H. Burr. New York: John Wiley & Sons. 978 pages. Price, $7.50.

Laboratory Exercises. Primary and Storage Batteries. By Karl E. Guthe, Ph. D. Ann Arbor, Mich.: George Wahr. 58 pages, 18 illustrations.

Electrically Operated Floating Dry Dock.

By Tom T. Donnelly.

The balanced floating dry dock, a view of which is shown herewith, was built by James Tregarthen & Son Co., foot of Seventh Street, East River, New York, and is of the well-known balanced type which has demonstrated its fitness for a great variety of dry docking work, and is justly so popular in this country.

The dock is 260 ft. long on keel blocks, 186 ft. 4 in. length of body, and 85 ft. wide. It has a depth at center of 10 ft. 4 in. and a height of wings sufficient to take a draught of 20 ft. over 3-ft. keel blocks. The dock is divided by a center longitudinal bulkhead, four side longitudinal and six cross bulkheads, into fourteen water-tight compartments, each of which is provided with two pumps.

The speed of the motor is 475 r.p.m., which is reduced by gearing to 110 r.p.m. of the line shaft, and to 56 r.p.m. for the pumps, which speed will pump the full capacity of the dock (3,000 tons) in about 35 minutes.

The motor is operated from the N. Y. Edison Company's mains at 240 volts, the current being led from the pier to the motor house on the dry dock by flexible cables. The whole is installed in a house shown on the right wing of the dock.

It is very essential in the docking of vessels to have a perfect and reliable control of the speed of the pumps, and the requirements of the contract were that the control should give at least ten different speeds, which should range from full speed down to 10 per cent. of full speed, and that the motor should operate continuously at any of the required speeds. As the motor is necessarily exposed to salt air and moisture, thorough insulation was very carefully provided for, and also the insulation of the pumping machinery (which, of course, is very thoroughly grounded to the water) from the frame of the motor. The installation has been an unqualified success, and has now been in operation for several months without interruption of any kind.

The series-parallel system of control, as built by the C. & C. Electric Company, and installed on this dock, is designed for a range of speed practically as great as can be obtained with a steam engine, and the motor may be operated for any length of time, at any speed from the lowest motion up to maximum, and the speed may be accelerated or retarded as rapidly as desired. This is accomplished without any abnormal consumption of current.

The armature of the motor is built with two commutators and independent windings, which are thrown into different relations automatically by the controller. On the lower range of speed these sets of windings are thrown in series, giving the effect of operating the armature on reduced voltage, and consequently reduced speed, which result is ordinarily obtained only by the use of wasteful armature resistance, externally applied.

The controller is operated by a single hand-wheel, shown in the photograph, and emergency switches are provided so that in case of accident to either set of windings the other set may be operated intact.

The pumping of dry docks is a class of work for which electricity

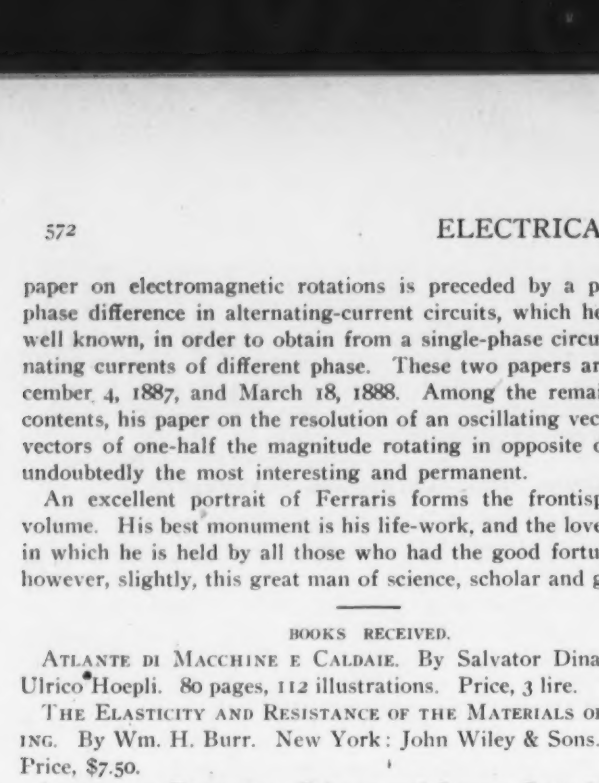


FIG. 1.—ELECTRIC FLOATING DRY DOCK.

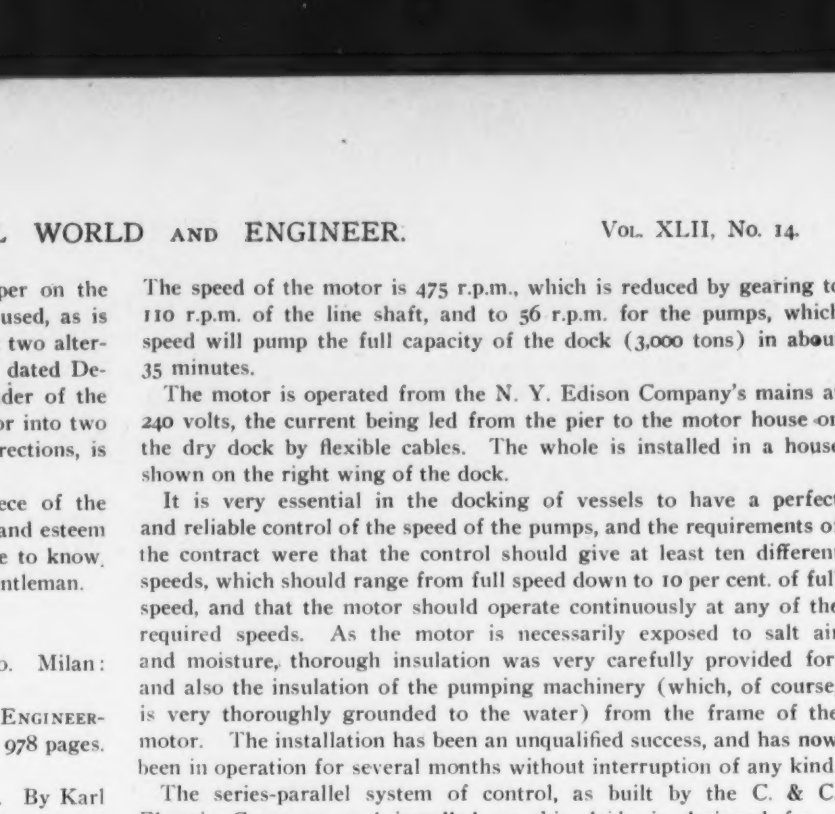


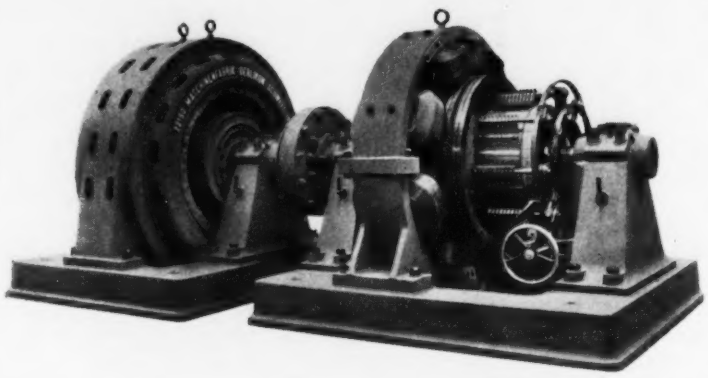
FIG. 2.—PUMP MECHANISM.

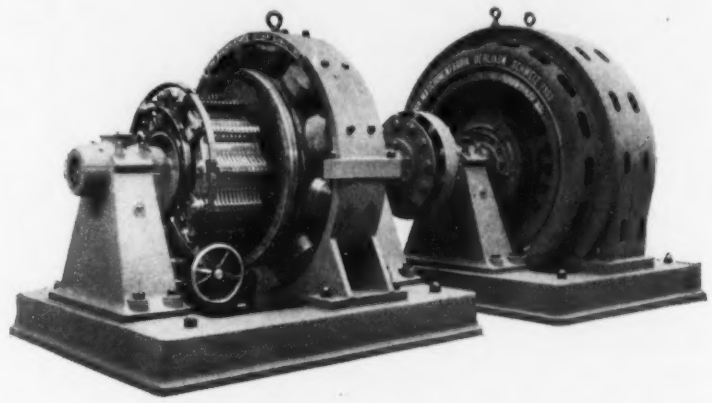
The pumps are of the standard dry dock pattern, 14 ft. square and 20-in. stroke. The pumps are operated by a 100-hp electric motor. The motor was especially designed for the work under specifications of Faber du Faur & Donnelly, engineers, by the C. & C. Electric Co., and is a special application of their series-parallel system of control.

is especially adapted, as it requires a large amount of power for but a short time and at uncertain intervals, and often at short notice; and where the source of electricity is available at any time of night or day, it is of especial value in case of an emergency which may require the docking of an injured vessel in the shortest possible time.

Tests of Oerlikon Motor-Generator Sets for the Stockholm Central Station.

Four motor-generator sets recently built by the Maschinenfabrik Oerlikon for the Stockholm electric station, serve for transforming 6,000-volt, three-phase currents of a frequency of 25 into direct current. The alternating-current motors are induction motors with starting resistances provided on the rotor. The four sets shown in Fig. 1 to Fig. 4 have the following capacities: That illustrated in Fig. 1 is a 500-kw set; the 6,000-volt, three-phase induction motor has a capacity of 600 kilovolt-amp. and is coupled with a 500-kw, direct-current dynamo, giving 440 or 600 volts; the number of revolutions is 375. In Fig. 2 is shown a 500-kw set; the voltage of the alternating-current motor is 6,000; that of the direct-current dynamo 220 or 300; the number of revolutions is 300. The set shown in Fig. 3 is of 250-kw capacity; the voltage of the alternating-current motor is 6,000; that of the direct-current dynamo 440 or 600, and the number of revolutions 500. The 65-kw set shown in Fig. 4 is for an alternating-current voltage of 6,000; that of the direct-current dynamo being 440 or 600, and the number of revolutions 500.





FIGS. 1 AND 2.—TWO VIEWS OF 500-KW SET.

All these machines were tested in the testing room of the Oerlikon Company with utmost accuracy and the best commercial measuring instruments. In the test of each machine the no-load losses were first determined for various voltages and the iron losses were separated from the friction losses; the copper losses, due to ohmic resistance, were then determined at full load. For each three-phase induction motor the coefficient of the magnetic stray field was measured, which, according to well-known and reliable theories, determines the phase difference between e.m.f. and current for different loads. For each direct-current dynamo the collector losses were measured and the commutation was studied for short-circuit and for different loads. Moreover, with the 250-kw and 65-kw sets, complete tests were made for a load varying from no-load to full-load. The direct-current generator of the 500-kw set, running at 300 revolutions, was also tested for full load. It was thus possible to compare the measured efficiencies of the sets for various loads with the efficiencies calculated from the separately-determined different losses; and to compare the measured phase differences for various loads with the phase differences determined from the coeffcient of the magnetic stray field.

It was found that the measure values of efficiency and phase difference were in extremely close agreement with the calculated values. Of course, on account of the difficulties and the inherent inaccuracy of direct measurement, the results thus obtained are of less value than those determined with great accuracy by the indirect method. An absolutely exact determination of the efficiency requires the use of three voltmeters, three ammeters and two wattmeters on the alternating-current side, and the use of one voltmeter and one ammeter on the direct-current side. Readings of all these instruments must be taken simultaneously and load and frequency and voltage of the three-phase currents must be kept absolutely constant for some time. It is obvious that this is extremely difficult to accomplish in practice.

Repeated careful measurements have convinced the engineers of the Oerlikon Company that only in very rare cases are the three-phase currents taken from a network really symmetrical, and that even small discrepancies from complete symmetry may have an important influence upon the results of the measurements. Therefore, besides the fact that the readings of the best measuring instruments are inaccurate by at least 0.5 per cent., there are always inherent sources of error involved in the direct measurement of the efficiency, and the result may be wrong by 2 per cent. On the other hand, under the conditions of the test, the error in the indirect determinations of efficiency can reach 2 per cent. only if errors of about 20 per cent. were involved in the separate measurement of the different losses. In the following diagrams, therefore, the values of efficiency are given as calculated from the single losses, and the values of phase difference as determined from the coefficient of the stray field as determined from the magnetizing current and the short-circuit current. There are thus neglected the losses which at full load are caused by eddy currents in the conductors which carry current and by distortions of the field. These additional losses must be very small, as may be shown by direct measurements and from measurements of the short-circuited machines.

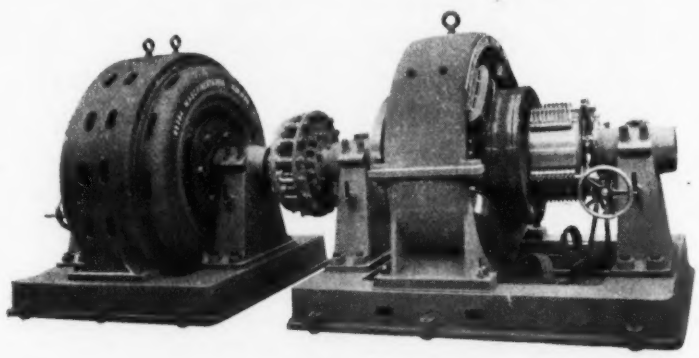


FIG. 3.—250-KW SET.

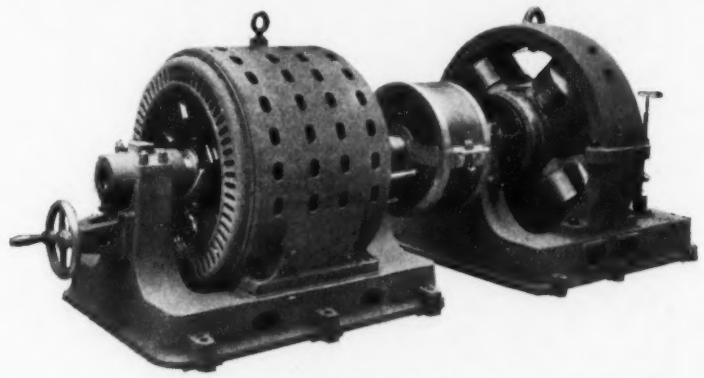


FIG. 4.—65-KW SET.

The commutator losses of the direct-current machines were calculated from the data (*) given by Dettmar in *Elektrotechnische Zeitschrift*, 1900, p. 429; the engineers of the Oerlikon Company have found these data to be in perfect agreement with repeated measurements made with their own commutators and their own carbon brushes.

* An abstract of this article was given in ELECTRICAL WORLD AND ENGINEER, 1900, June 23, page 949.

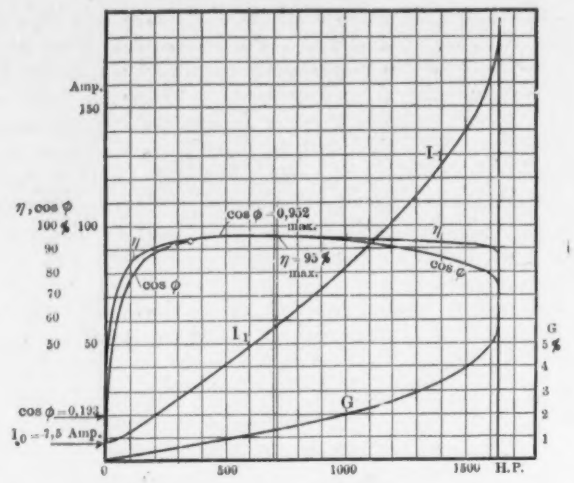


FIG. 5.—TEST OF 500-KW SET (FIG. 1).

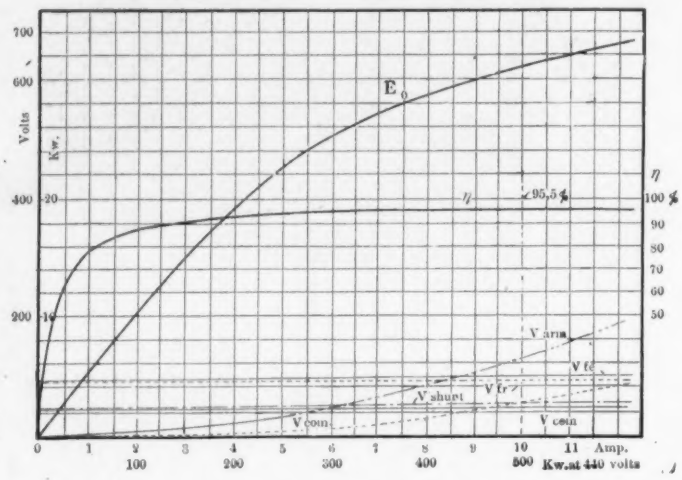


FIG. 6.—TEST OF 500-KW SET (FIG. 1).

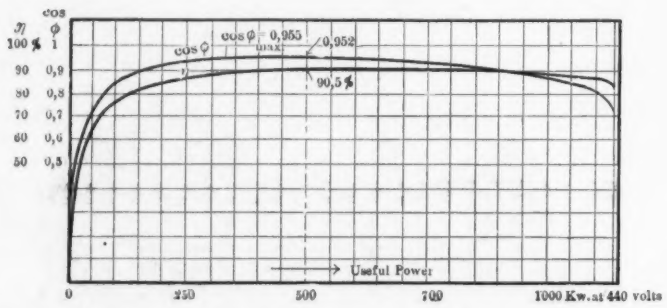


FIG. 7.—TEST OF 500-KW SET (FIG. 1).

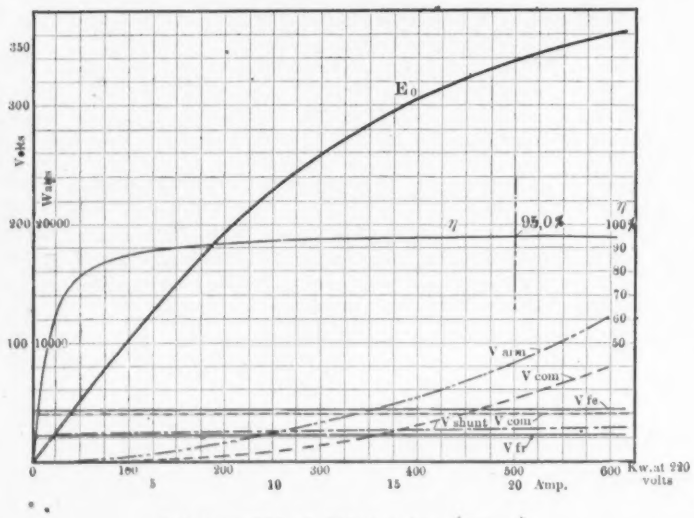


FIG. 9.—TEST OF 500-KW SET (FIG. 2).

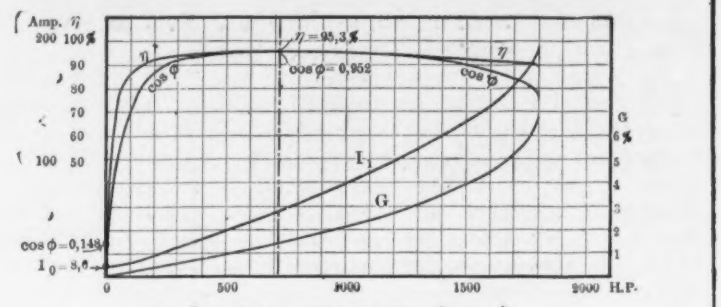


FIG. 8.—TEST OF 500-KW SET (FIG. 2).

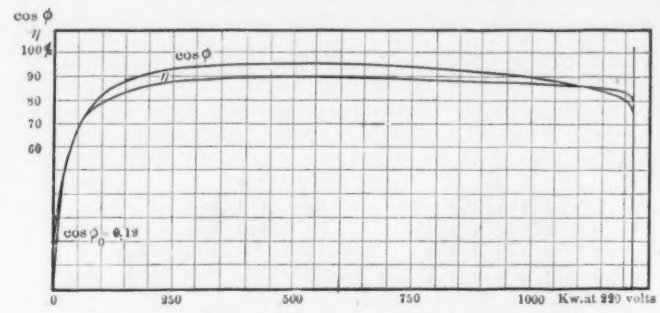


FIG. 10.—TEST OF 500-KW SET (FIG. 2).

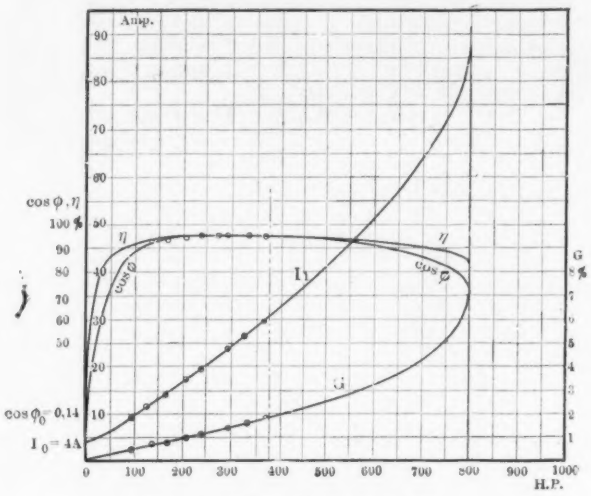


FIG. 11.—TEST OF 250-KW SET.

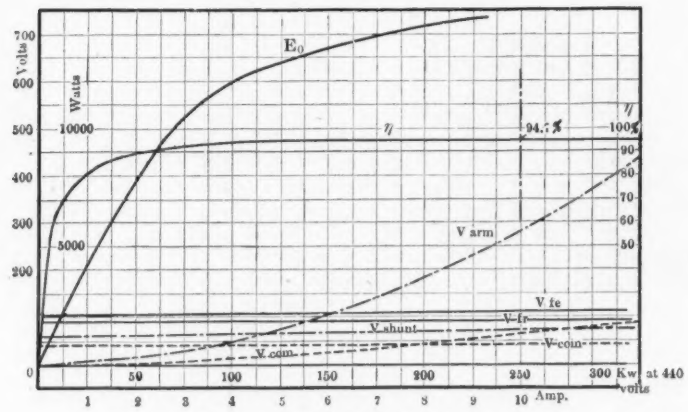


FIG. 12.—TEST OF 250-KW SET.

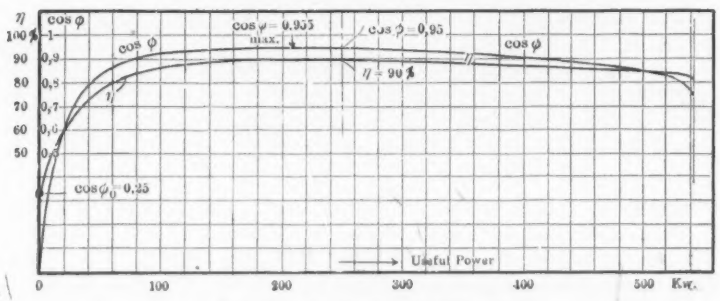


FIG. 13.—TEST OF 250-KW SET.

TESTS OF OERLIKON MOTOR-GENERATOR SETS, STOCKHOLM.

The results of the tests of set I (Fig. 1) are given in Figs. 5, 6, 7; those of set II (Fig. 2) in Figs. 8, 9, 10; those of set III (Fig. 3) in Figs. 11, 12, 13; those of set IV (Fig. 4) in Figs. 14, 15, 16.

Fig. 5 gives the curves for the 720-hp, three-phase induction motor of set I, tested at a voltage of 6,000 and a frequency of 25, and running at 370 r.p.m., the rotor being disconnected from the direct-current generator. I is the current supplied per phase to the stator, η is the efficiency in per cent., $\cos\phi$ the power factor, and g the slip in per cent. The efficiency is 95.2, 95.2, 94.5, 90.0 per cent. at full, three-quarters, one-half, one-quarter load, respectively; the power factor is 0.95, 0.952, 0.94, 0.84, respectively; the slip at full load is 1.47 per cent.; the overload capacity is 225 per cent., and the no-load current is 7.5 amp.

To illustrate how the efficiency was determined, in the case of full load, the no-load losses are 13.5 kw, the primary copper loss at full load 6.3 kw, the secondary copper loss 7.9 kw; hence, the total losses, 27.7 kw; the energy supplied to the motor is 555 kw, of which 27.7 kw are lost; hence, the efficiency, 95.2 per cent.

Fig. 6 gives the curves for the 500-kw, direct-current generator of set I, supplying 1,140 to 830 amp. at 440 to 600 volts, respectively. e_0 is the characteristic curve for no-load, giving the volts at open circuit as a function of the exciting current. The scale for the exciting current is the upper horizontal scale at the bottom of the diagram, reading from 0 to 11 amp.; the scale for the voltage is the vertical one at the left-hand reading, from 0 to 700 volts. η is the efficiency. $V\,arm$ is the ohmic loss in the armature copper. Vkd is the loss at the commutator, due to the transition resistance between the segments and the brushes; V_{KR} is the mechanical loss at the commutator; VFe is the loss due to hysterisis and eddy currents; $V\,err$ is the loss in the field copper and in the shunt regulator; V_{R+V} is the loss due to friction of the bearings and to ventilation. The scale for all these losses is the vertical one at the left-hand reading from 0 to 20 kw.

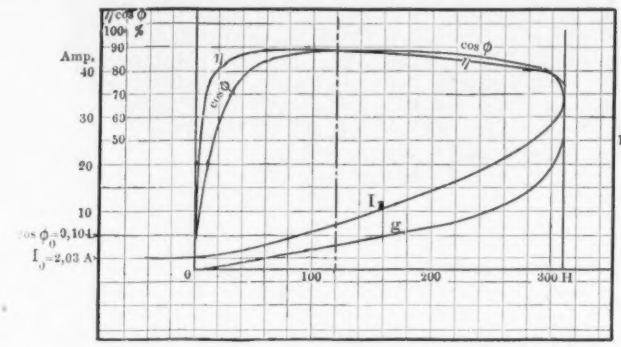


FIG. 14.—TEST OF 65-KW SET.

To show by an example how the efficiency is determined, the following table gives the amounts of the different losses at full load for 440 volts and 600 volts:

Single losses in kw at full load at	440 volts.	600 volts.
Ohmic loss in armature copper	7.4 kw	4 kw
Loss due to transition resistance at commutator.	2.5 kw	1.7 kw
Mechanical loss at commutator	2.3 kw	2.3 kw
Loss in armature iron	4 kw	13.4 kw
Loss in field copper and in shunt regulator	2.6 kw	6.3 kw
Loss due to friction of bearings and ventilation	5 kw	5 kw
Total loss at full load	23.8 kw	32.7 kw

The output of the machine is 500 kw; hence, output plus losses is 523.8 or 532.7 kw for 440 or 600 volts, respectively. The efficiency is, therefore, 95.5 per cent. for 440 volts, and 94 per cent. for 600 volts. The curves in Fig. 6 refer to 440 volts.

Fig. 7 gives the curves for the complete set I; $\cos\phi$ is again the power factor, η the total efficiency of the motor generator. The scale of the abscissæ gives the output in kilowatts, at 440 volts.

Fig. 8 gives the curves of the 720-hp, 6,000-volt, three-phase motor of set II, running at 296 revolutions; the notation is exactly the same as in Fig. 5. The total no-load loss at 6,000 volts is 13.2 kw, and the no-load current is 8.6 amp. The efficiency is 95.0, 95.2, 94.5, 91.5 per cent. at full, three-quarters, one-half and one-fourth full load, respectively, and the power factors are 0.953, 0.950, 0.934, 0.85, respectively; the overload capacity is 250 per cent., and the slip at full load is 1.5 per cent.

Fig. 9 gives the curves of the 500-kw, direct-current generator of set II; the notation is exactly the same as in Fig. 8. The dynamo may be used at 220 to 300 volts, the figures in the diagram referring to 220 volts. The total loss at full load at 220 volts is 26.2 kw, the efficiency is 95, 93.8 and 90 per cent. for full, half and quarter load, respectively, at 220 volts.

Fig. 10 gives the curves of the complete set II, the notation being exactly the same as in Fig. 3.

Figs. 11, 12, 13 give the curves for the induction motor, the direct-current generator, and for the combination of both machines for set III. The notation is again the same as in Figs. 5, 6, 7. In Fig. 2 the points surrounded by small circles were found by direct measurement, while the curves were indirectly determined as above stated. The curves in Fig. 12 refer to a voltage of 440. Figs. 14, 15, 16 give the corresponding curves for set IV, the curves in Fig. 15 referring to a voltage of 440.

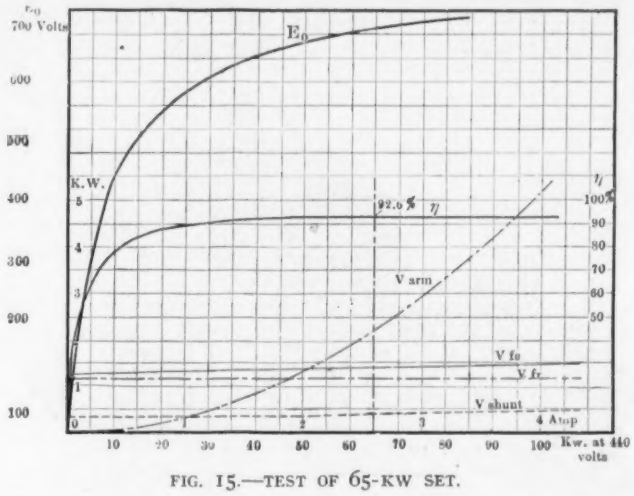


FIG. 15.—TEST OF 65-KW SET.

Finally some of the results of the temperature measurements may be given. As the induction motor of set I could not be tested at full load, it was operated unloaded at 8,000 volts for six hours. At the start the temperature of the iron was 14° C.; that of the surrounding air being 13°; at the end of six hours these temperatures were 58 and 21°, respectively.

The direct-current generator of set I was operated for five hours at 353 volts, 1,180 amp., 363 revolutions, and 4.6 amp. exciting current. After five hours the temperature of the room was 21° C.; that of the armature, 42; commutator, 56; magnet coils, 32°. The same generator was operated for ten hours at 600 volts, with 390 amp., the number of revolutions being 385 and the shunt exciting current 8.1 amp.; at the end of the ten hours the temperature of the room was 19.5° C.; armature, 36; commutator, 35.5; magnet coil, 44° C.

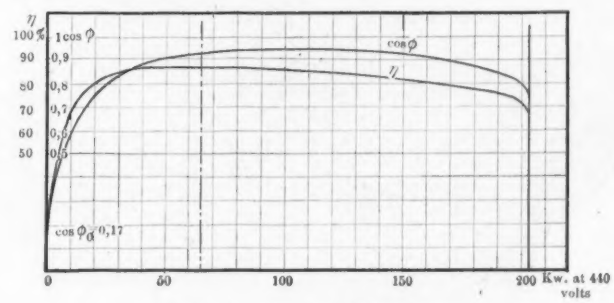


FIG. 16.—TEST OF 65-KW SET.

The induction motor of set III was operated at full load (250 kw) for six hours. At the start the temperature of the room was 17.5° C., that of the motor casing 22°; after six hours the temperature of the room was 26°; that of the motor casing 45°; that of the stator winding 65°.

The Oerlikon Company claim that these results are considerably better than any obtained up to the present in Continental Europe.

Telegraphers' Tournament.

A telegraphers' tournament will take place on October 30 and 31 in the auditorium of the National Export Exposition Buildings, Philadelphia.

New Standard Types of Siemens' Dynamos and Motors.

The large and growing demand for dynamos and motors, together with the keen competition, has caused many of the British manufacturers to investigate closely their types of apparatus with a view to standardizing them, and so being able to reduce the expense of manufacture and more successfully compete in the markets of the world. Among the companies who recognized that much could be done in this field was Siemens Brothers & Co., Ltd., of London and Woolwich, and while their great new factories have been gradually taking shape at Stafford, where they will soon have one of the best equipped factories in Great Britain, they have been busy devising a complete new

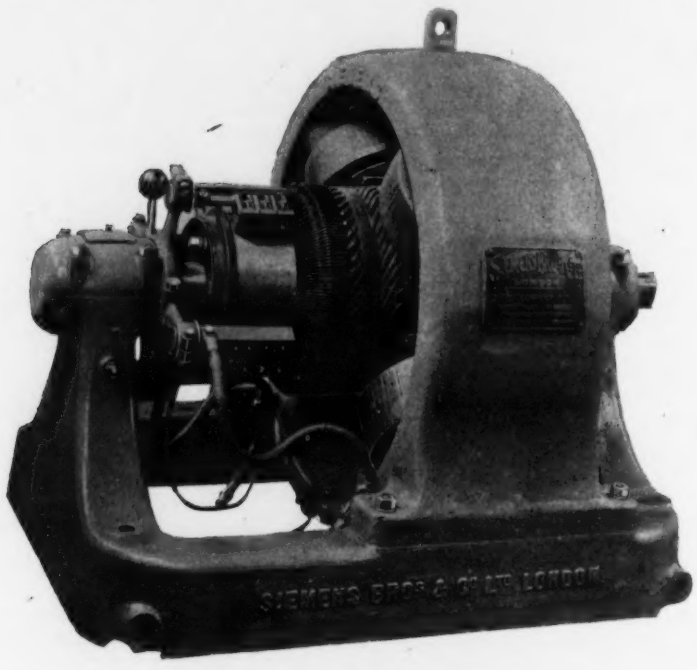


FIG. 1.—50 TO 125-HP MACHINE.

line of direct-current motors and dynamos which are thoroughly up-to-date in design, both electrically and from the manufacturing point of view. In this work they have been most ably assisted by Mr. A. S. Clift, who was for so many years chief draughtsman of the Crocker-Wheeler Company, of New York. These new standardized types are now ready for the market, and we illustrate several of these machines above

The machines have been divided into four types as follows: ½ to 2 hp, shown in Fig. 3; 2 to 50 hp, shown in Figs. 2 and 4; 50 to 125 hp, shown in Fig. 1; and 75 to 3,000 kw. In all types the armatures are of the slotted drum type form-wound, and with field coils form-wound. The type including machines from 2 to 50 hp. is made in two forms, open and closed, as shown in Figs. 2 and 4. The magnet frames of all machines are of cast-iron with wrought-iron poles cast-welded into the frame and fitted with laminated pole shoes screwed to the pole face.

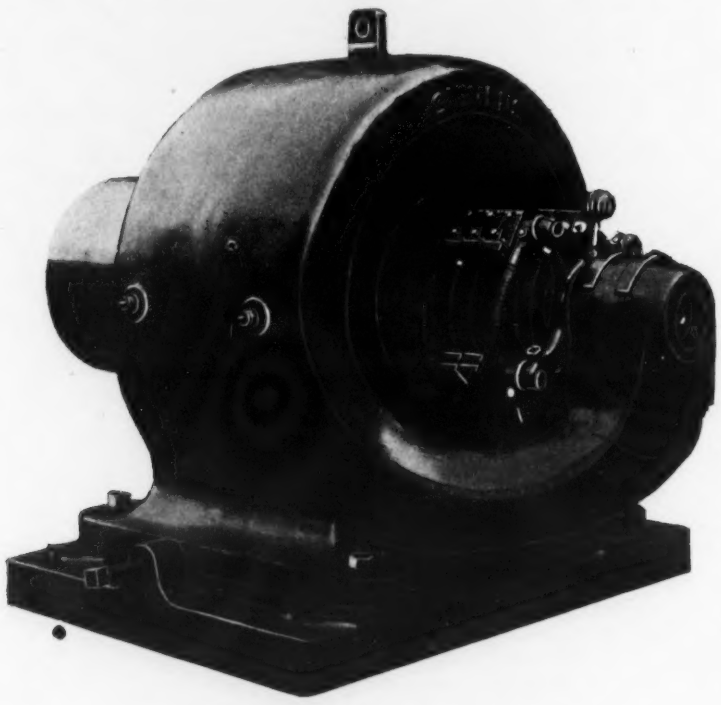


FIG. 2.—2 TO 50-HP MACHINE—OPEN TYPE.

New Plant at Niagara Falls.

By the middle of October the By-Products Paper Company will have its big plant in operation. This factory was expected to start by October 1, but the failure of an engineering company to deliver one of its boilers has caused the delay. At the outset this plant will employ about fifty men. As the demand for the product increases, as competent authorities declare it is bound to do, the plant will be enlarged. It is believed that within a few years this will be one of the largest plants at Niagara Falls. About fifteen tons of paper stock per day will be the output at first, flax fibre being used in making the stock.

FIG. 3.—½ TO 2-HP MACHINE.

FIG. 4.—2 TO 50-HP MACHINE—ENCLOSED TYPE.

Typo-Telegraphy.

Printing telegraphy has been a much discussed question, and the demand is to secure a system which will be profitable for commercial telegraphy, with the gratifying results of confining it to an economical and simple system. From the earliest attempts at printing telegraphy, the only means of transcribing telegraph messages into printed form, has been by the use of a typewheel, of uniformity of revolution, and in harmony with the positive impulses sent upon the line from the transmitter. However mechanically accurate a printing telegraph system may be constructed, upon the well-known principles of controlling the typewheel by a step by step movement, difficulty arises in obtaining correct operation under high speed, even upon short circuits. In other forms of printing telegraph, the uniform rotation of the transmitter and the typewheel is maintained by synchronous rotation of the motors at each end of the circuit. Each of these systems has correcting devices which are peculiar to their construction.

Dr. George A. Cardwell, of New York, has patented a system of printing telegraphy, commonly called the typo-telegraph, which is peculiarly simple in construction, and appears to have proved its applicability to commercial telegraphy.

The typo-telegraph is not to be classed with any system which sends peculiar signs or signals on a tape, to be mechanically transposed into a printed message. The typo-telegraph requires but one operator at the transmitting end. There is no prior preparation of the messages on a tape. The messages are sent directly to the line by the transmitter, operated by the sender. There is no duplicate handling of the messages. The receiving instrument automatically records the messages on a printed blank ready for delivery. The only assistance that the receiving instrument requires is a daily supply of blanks, of which some three hundred are placed in the machine in a roll, which works automatically.

There are always three electrical pulsations used for each character of the alphabet, and these pulsations may be sent out with no lapse of time between the pulsations for each letter, in order that the letter may be selected and printed. Hence the selection and printing of any character is brought about by three impulses of current, which are of different polarity.

Experiment has taught that to obtain the best results in long line telegraphy it is necessary to diminish the number of impulses and to make these impulses as short as possible. This rule applies more particularly to printing telegraphy than any other system. Therefore, the transmitting device for the typo-telegraph consists of a universal keyboard, which covers the range of all letters, figures, fractions, punctuations, etc., neecssary for commercial uses. Upon the depression of any one of the keys, three impulses are sent directly upon the line from three magnets, which close consecutively, throwing into the line the impulses distinctly and clearly, as if they were three dots of the Morse system. These pulsations are sent very rapidly, because the touch of the keyboard is a staccato touch, and is capable of more rapid action than the skill of any operator in striking the keys. It is a fact that no rhythmical operation can be maintained by any operator working at a high rate of speed. No average transmission of words can be obtained, because the operator is liable to be erratic in the manipulation of the keyboard, and certain words may be sent at the rate of one hundred and fifty words per minute, while other words may be sent at a much lower rate. Therefore, the actual printing of messages by a skilled operator, to be correct, is placed at sixty words per minute, although the system has the maximum capacity of printing a hundred and fifty words per minute and more.

Should any impulse be lost upon the line from high inductive disturbance, or the transmissions of the electrical impulses be disturbed by the carelessness of the operator in striking two keys at once, the typewriter will leave a blank space, indicating the loss of one letter. The line has absolute clearness after the transmission of any three impulses, or the printing of a letter, whether correctly or not.

The number of selected combinations in the transmitter is limited to thirty-six, which control the same number of local circuits in the permutating apparatus. These combinations can be changed into the thousands, which are all mathematically and electrically correct, thereby allowing the system to be used in secret service without any danger of wire-tapping or the revealing of any important message. It is a simple mathematical problem electrically solved into direct individual working circuits. There is no clock-work or synchronizing device but the closing of any three magnets of a series of four, which in their sequence remain closed until the character is printed, when they are automatically restored to their normal condition by the printing mechanism.

One magnet controls the movement of the typewheel, and thereby insures a steady and quick movement, with sufficient surplus power to maintain a maximum amount of speed to offset any erratic working of the operator. The carriage is moved in rhythmical step with the printing of each character, and at the end of the line is automatically returned to its original position and the line space given, absolutely under the control of the operator.

The peculiarity of the typewriter carriage is that it will never overthrow a line, is always controlled by the will of the operator, and each blank, after the message has been printed, is thrown into position ready to be taken out and delivered without stopping the working of the system. As each message is finished another blank is immediately thrown into position, thus avoiding any delay on the part of the operator in the continuance of his work. It would seem from the simplicity of the line conditions of the typo-telegraph that it can be operated at all times upon a telephone circuit without any interference to the telephone. The two systems can be worked conjointly on the one circuit.

The typo-telegraph requires but a space of a foot and a half square, and can be put in any convenient place in a telegraph or private office. It is stated that the system has been successfully worked between New York, Washington and Boston, transmitting and printing messages at the rate of 75 words per minute.

Extensive Cuban Traction and Lighting Projects.

An extensive electric traction and lighting system is to be constructed in the southern part of Cuba, power being derived from a hydraulic plant, which will be the largest in that part of the world. The Cienfuegos, Palmira & Cruces Railroad & Electric Power Company has been organized for the purpose of building and operating both systems. The bulk of the capital will be furnished by Cubans. Bruno Diaz, a large Cuban cigar manufacturer, is president of the company. Cornelius C. Vermeule, 203 Broadway, New York, is acting as consulting engineer. The length of the road will be about 43 miles. Four and a half miles of track will be constructed in the busy seaport of Cienfuegos. The line will run from Cienfuegos to Caonao, thence over a private right of way to Palmira, Harmiguero and Cruces. There will be a branch also over a private right of way, from Caonao eastward, 15 miles, through Los Guaos to Cumanayagua. From the harbor of Cienfuegos to Caonao there will be a second line on a private right of way built to carry freight exclusively.

The track will be of the standard gauge. Sixty-pound T and girder rails will be employed. The initial rolling stock will consist of four combination cars, 32 ft. over all, seating 24 persons and operated by two 50-hp motors each; four open passenger cars, 35 ft. 8 in. over all, seating 60 passengers and operated by two 50-hp motors each; three closed passenger cars, 27 ft. 8 in. over all, seating 24 passengers, and operated by two 25-hp motors each; three 8-bench open cars, 25 ft. over all, seating 40 passengers and operated by two 25-hp motors each. Five express cars 21 ft. over all, equipped with four 50-hp motors each and having a capacity of 20 tons will be ordered, also twenty box, 8-wheel freight cars, capacity 20 tons; a similar number of 8-wheel flat cars, capacity 20 tons, also sprinkler and repair cars.

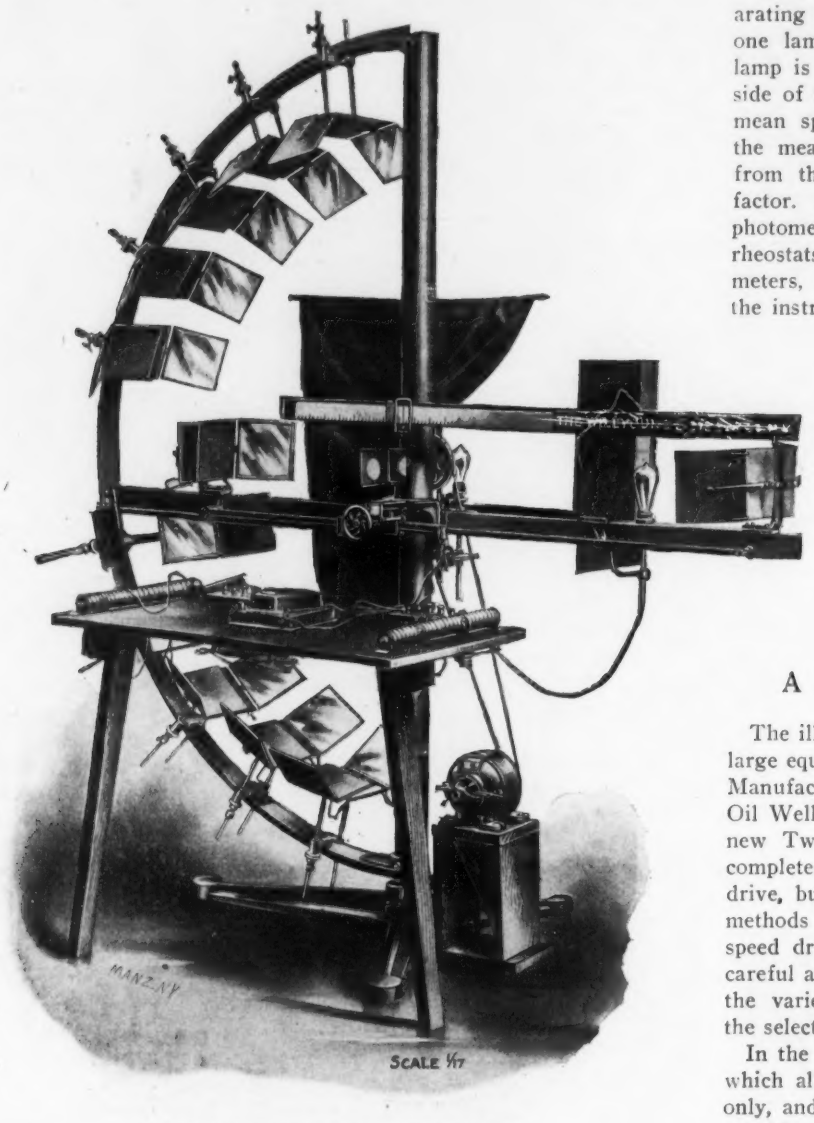
The company will also generate energy for the purpose of lighting Cienfuegos—about 30,000 inhabitants—and the other towns mentioned whose population averages about 8,000 people. Power will be derived from the Falls of Hababanilla, which are known as the Niagara of Cuba, located about 26 miles from Cienfuegos. The voltage at which the energy will be transmitted has not yet been determined. The initial capacity of the plant will be 3,000 hp, extensions being provided for.

The Cuban port of Santiago is also to be lighted by electricity. Hugh Reilly, formerly a New York contracting engineer and now permanently resident in Cuba, is primarily interested in the project. There will be about 10,000 16-cp lights on the commercial circuit and 320 arcs for street lighting. A steam power generating plant will be constructed. The initial capacity will be 1,500 hp in three units. The entire project will be carried out according to the most modern ideas in hydraulic, electrical and steam engineering. Mr. Reilly's address is Hotel Pasaje, Havana.

The Matthews' Spherical Candle-Power Photometer.

We illustrate herewith the latest model of the integrating photometer for direct reading measurements of spherical candle-power, invented by Prof. Matthews, of Purdue University. The complete theory and discussion of principles upon which the instrument is based were given in a paper presented before the American Institute of Electrical Engineers, and will be found in their transactions of November, 1902. This theory shows that the mean spherical candle-power is proportional to the illumination of a photometer screen receiving its light from 11 pair of mirrors placed at equal angles about the arc of a half circle having the lamp and screen respectively at the two centers of the two parallel arcs of mirrors. The instrument as perfected commercially is a device which offers the only solution of practical mean spherical measurements.

The instrument may be used as a simple photometer for ordinary horizontal measurements; as an integrating instrument for the direct determination of mean horizontal, mean spherical, mean hemispherical or mean zonular candle-power; and as an integrating photometer for the direct determination of the spherical reduction factor—that is, the ratio of mean spherical to mean horizontal candle-power. All these measurements can be made by one operator with one observation with great accuracy, ease and convenience.



SPHERICAL CANDLE-POWER PHOTOMETER.

As may be seen from the cut, the eleven pair of mirrors are supported at proper intervals (15°) by a semicircular frame connected to a central pillar. The "unknown" is behind the curtain, and while under test, is spun around on its axis in a rotator. The rays of light sent out at different angles from the lamp are reflected by the mirrors in such a way that they all meet again upon the photometer screen, seen directly opposite the lamp in front of the central pillar. The other side of the screen is illuminated by the standard, but with the horizontal rays only, by aid of two reflecting mirrors. These two mirrors slide along a horizontal bar so as to increase or decrease the distance from the screen to the standard, which is located in the same plant with the unknown, and shielded from it by means of an opaque screen. When balance is obtained the value of the unknown can be read from a scale moving with the sliding mirrors and passing behind a pointer screwed at the central pillar. Thus the mean spherical candle-power of a lamp is readily determined, and it is done without formulæ or figuring.

The apparatus may also be used as an ordinary photometer bench for comparative measurements; for this purpose the two horizontal pair of mirrors only are used, all other mirrors being closed. Both horizontal mirror pairs are now connected to the sliding bar, which is moved to and fro by the rack so as to vary the distance between the screen and the two lamps for a constant distance between the lamps themselves. The scale for horizontal candle-power is used.

To obtain the spherical reduction factor, the opaque screen separating the unknown and the standard lamp is removed, and but one lamp—that whose reduction factor is wanted—is used; this lamp is placed in the rotator, and if all mirrors be uncovered one side of the photometer screen is illumined proportionately with the mean spherical candle-power, the other side proportionately with the mean horizontal candle-power of the same lamp. A reading from the scale at the balance of the screen gives the required factor. A table attaches to the main pillar and rests in front of the photometer, as shown. On this table are mounted the controlling rheostats and the various binding posts for attachment of the voltmeters, ammeters, etc. The table is permanently wired so that the instrument is always ready for use.

The Matthews photometer has been in daily commercial use now for some months by the Lamp Testing Bureau of New York. It is also being used by the Sawyer-Man Lamp Company, the Edison Lamp Company, at Harrison, etc., etc. Among research laboratories that have installed the instrument may be mentioned Cornell University, Leland Stanford, Jr., University, Washington University, Polytechnic Institute of St. Petersburg, etc., etc. The Messrs. Willyoung & Gibson Company, No. 40 West Thirteenth Street, New York, are the manufacturers.

A Large Installation of Variable Speed Motors.

The illustration shown on page 579 gives a view of a portion of a large equipment of multi-speed motors recently installed by the Stow Manufacturing Company, of Binghamton, N. Y., in the works of the Oil Well Supply Company, at Pittsburg and Oil City, Pa. In their new Twenty-first Street (Pittsburg) factory, which was recently completed, this company proposed from the start to use the electric drive, but for a time were undecided as to which of the various methods proposed was best suited to their requirements of variable-speed driving. The question was finally decided after a series of careful and rigorous competitive tests of the motors and methods of the various manufacturers. These comparative tests resulted in the selection of the Stow multi-speed motor.

In the selection of this motor the situation required a motor with which all the speeds could be obtained by the use of one voltage only, and one which should be able to develop continuously its full rated horse-power at its lowest as well as its highest speed, and with an efficiency as high at the minimum speed as at the maximum. These conditions were admirably fulfilled throughout a severe test, and orders were placed for 30 Stow motors to be used for the driving of individual machine tools, lathes, slotters, etc. The accompanying illustration shows a group of 4-hp Stow motors driving 26-in. Bridgeford lathes.

The severity of the original test on this 4-hp motor may be inferred from the fact that steel chips, averaging about one-half an inch wide and one-sixteenth of an inch thick were turned off at the rate of 75 ft. per minute, throwing a 100 per cent. overload on the motor, and causing the point of the tool to melt. The above test, in which the steel chips were removed at the rate of 28 cu. in. per minute was repeated several times, and while it required from thirty seconds to one minute to put the cutting tool out of order, the motor received no damage whatever.

In this installation there is a noticeable absence of all auxiliary apparatus and wiring, as the motors are entirely self-contained and operate on one voltage only. As no resistance or rheostat of any kind is used to regulate the speed, the electric circuits of the motor remain absolutely unchanged.

Reversible motor starters of the Cutler-Hammer type are used to bring the motors up to speed, and when mounted on lathes the speed-regulating hand wheel is located on the side of the motor in a position most convenient for the operator, as shown by the cut.

INSTALLATION OF MULTI-SPEED MOTORS.

A World's Record in Coal Hoisting.

A great advance in the speed of handling coal from freight vessels and barges falls to be recorded, a world's record for rapid unloading having been recently established by the C. W. Hunt Co., West New Brighton, N. Y., at the Lincoln Wharf Power Station of the Boston Elevated Railway Company. Run of mine bituminous coal was raised 90 ft. above the tide water from one hatch of a vessel and delivered to the storage pockets cracked to mechanical stoking size, at the rate of 320 tons per hour, by one tower. This is an advance of about 200 per cent. upon the previous best record, and marks an important mechanical engineering achievement.

To attain this end the steam engines of fifty to 100 combined horse-power in common use have been replaced by machinery of

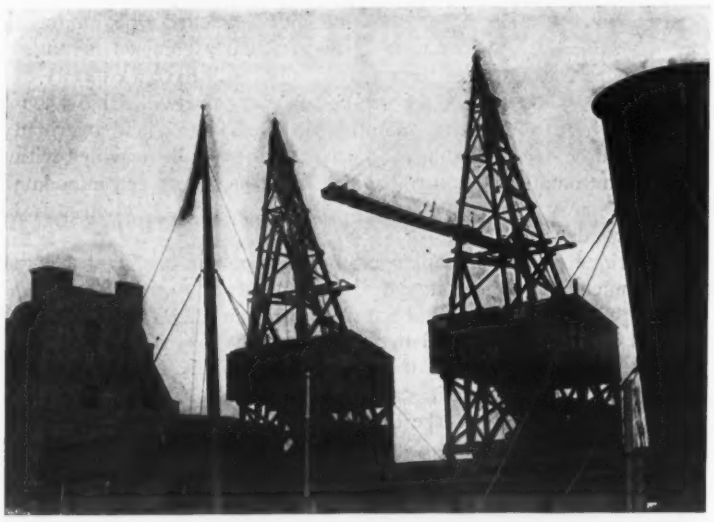


FIG. I.—COAL HOISTING.

300 hp, and the coal-cracking machine attached to the tower cracks to the proper dimensions for automatic stokers, before passing to the pocket the enormous quantity of coal, over 5 tons per minute, delivered to it from the hoisting machinery. The ordinary small steam shovel has been supplanted by an automatic one of two tons' capacity at each lift. The time occupied in raising two tons of coal from the hold of a vessel to the discharging hopper, nearly 200 ft. above, is only 6 seconds, while the round trip, involving the operations of lowering and moving the shovel out of the boom, opening the former, digging up two tons of coal, raising it to the level of the hopper and discharging it therein, is frequently performed in 22 seconds.

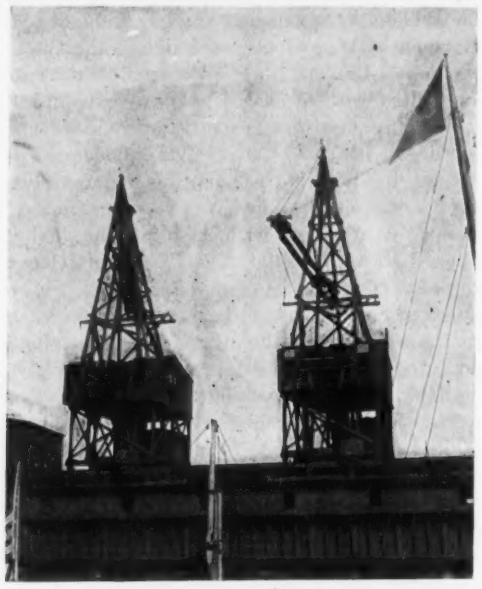


FIG. 2.—COAL HOISTING.

The installation, shown in the illustration, follows in general design, but in heavier proportion, the standard Hunt "Steeple Tower" rig, the moving gear and coal cracker being electrically driven and the hoisting engine direct-connected. The towers have to traverse overhead the whole length of the coal storage pocket and to move 30 ft. at a time without changing steam connection. In this way a single tower can operate on each hatch of a vessel in turn, or several towers can work simultaneously. The boom, made to fold up, for the free manipulation of vessels with their rigging, has an overhang of 40 ft., and enables the tower to operate on coal steamers of the widest beam and largest dimensions.

Trolley Catcher Development.

A simple and effective form of trolley catcher has lately been introduced by Johnson & Morton, of Utica, N. Y., and the construction of the device shows how great an improvement has been effected in this minor but important attachment for street-car service. The appliance is shown complete and in detail in Figs. 1 and 2. In re-

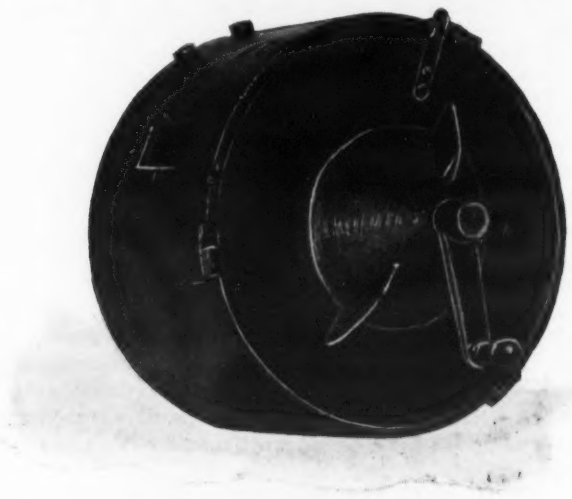


FIG. I.—TROLLEY CATCHER COMPLETE.

gard to its operation, it may be noted that the rope draw rests by its own weight on a bearing in the case without a cap. The slack trolley rope is wound on the drum by a plain coiled spring. When the speed of the unwinding cord is suddenly increased, the drum is lifted from its bearing before the cord unwinds, and a ratchet on the drum-head engages a stationary tooth in the case above it, thus preventing the drum from turning. On account of this rapid and positive action, barely half an inch of rope is paid out before the catcher operates, and the trolley pole is thus held below the level of the span wires.

The catcher will coil fifteen feet of ¼-in. rope. Three-eighths-inch rope may be used, although ¼-in. rope is recommended. The heavier rope is not required with this catcher, as the movement of the trolley poles after leaving the wire is so short, the severe strains from suddenly stopping it are avoided. The base is fastened to the bar by three bolts, and has a substantial bayonet lock so that the catcher proper can be removed by a half turn of the case. Accidental loosening of the case is impossible. This makes it possible to use only one catcher upon reversible cars, as a base can be fastened on each end, and the catcher taken from one end to the other when the trolley is reversed. A chain is provided on the cord drum, so that the trolley cord can be attached by a hook. A crank extending from the head of the case is connected with the cord drum so the spring can readily be wound up. The head of the case is fastened by a latch joint so arranged that it can be taken off instantly, but cannot come loose by accident.

When the case-head is removed, the spring, cord, drum and interior of the case are at once accessible. The spring is held in a recess in the case-head and can be taken out without the use of tools for replacement or inspection.

Fig. 2, with the drum case open, shows the construction and principle of operation. Both the bearing in the case and the head are of

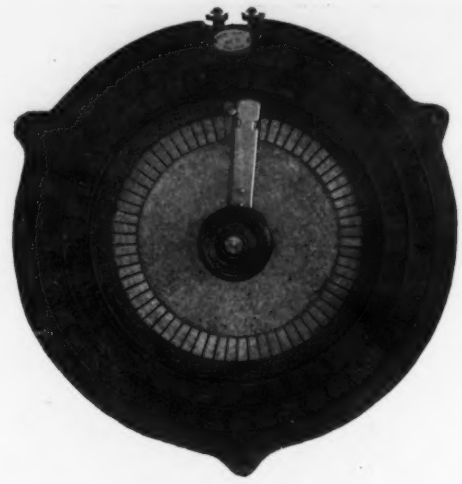
FIG. 2.—DETAILS OF TROLLEY CATCHER.

chilled iron, to prevent wear. The drum shaft and spring shaft are of best mild steel, and can be renewed with but little trouble or expense. The rack upon the cord drum is of chilled iron, and the catch of case-hardened steel. The spring is fifteen feet in length, of finely tempered steel, and winds upon a shaft one inch in diameter, ensuring durability.

Field Regulator.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has recently placed upon the market a new type of field regulator, an illustration of which is shown herewith. It consists of a base of insulating material, to which are attached the resistance wire contacts and lever, the whole being carried by a japanned iron casing, which not only gives the instrument a handsome finish, but prevents the possibility of direct contact with the heat-radiating portion of the rheostat. No enamel or similar material is used in the construction, and the resistance material itself cannot possibly disintegrate through misuse. It is claimed that grounding is impossible on account of the insulating base; and the compound by which the various current-carrying parts are attached thereto is of such nature as to become practically part of the base when the apparatus itself is complete. This substance possesses the qualities of insulation, heat conduction and radiation to a marked degree, and is so little affected by heat that the resistance wire has frequently been run white hot by passing excessive currents through it, without in any way causing the compound to deteriorate or separate itself from the base. This insures the maximum factor of safety for the apparatus, as it makes certain that current will be carried without permanent damage up to the actual burning-out point of the wire itself. The working parts of the apparatus are all amply proportioned for their designed load.

With these field rheostats for rear of switchboard mounting is furnished a novel 5½-in. hand-wheel, which is made throughout of



FIELD REGULATOR.

copper, handsomely polished and lacquered. It is obvious that a hand-wheel of this kind possesses many advantages over the ordinary plated hand-wheel, the plating of which in time rubs off and presents a bad appearance. The insulation is of the simplest character, consisting of but a single large piece, and consequently the loosening up of small parts has been entirely done away with, a feature which will be appreciated by those familiar with the ordinary form of insulated hand-wheel.

Turbines for Pennsylvania Railroad Plant.

An order for three steam turbines of the largest size has recently been placed with the Westinghouse Machine Company, East Pittsburg, Pa., by Westinghouse, Church, Kerr & Company, acting as engineers and constructors for the Pennsylvania Railroad in connection with the New York Terminal equipment. These machines will form the initial installation in the new Long Island power house, on which construction is just beginning, and which will serve the traction in the tunnels for the Hudson and East Rivers and the New York Terminal at Thirty-second Street and Seventh Avenue, and also such part of the Long Island Railroad System as is in process of conversion to electric traction.

The turbines will be of the horizontal short-barrelled type, mounted upon a single bedplate, resulting in a particularly compact arrangement and great economy of floor space. They will have a capacity of approximately 7,400 electrical horse-power each, and will drive 5,500-kw, three-phase generators operating in parallel. Their overload capacity will be over 11,000 hp, and each turbine will be provided with a by-pass automatically controlled by the governor to accommodate abnormal fluctuations in load. This will also permit operation at full load non-condensing.

The turbine equipment will operate under conditions favorable to the attainment of high economy, viz.: 200 pounds steam pressure at the throttle, 28 in. vacuum and 175 degrees F. superheat. The generator will be direct connected to the turbine shaft through a flexible coupling, each section of the unit having two bearings of ample proportion, thus avoiding shaft stresses. The three-phase winding will deliver current directly to the distribution system at 11,000 volts, no step-up transformers being employed. The machines will be separately excited, and will carry full load continuously at 100 per cent. to 80 per cent. power factor, with a rise in temperature of 35 degrees C., or 50 per cent. overload for two hours with an increase in temperature rise of slightly over 50 per cent. Each turbo unit will thus be capable of delivering 8,250 kw for reasonable intervals, and considerably in excess of this figure during momentary load fluctuations. The entire equipment will be delivered by July, 1904, one year from the date of contract.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was another sharp break of liquidation and bearish activity during the week, the feature of the movement being the heavy declines in the securities of the United States Steel Corporation. Railroad shares have likewise fallen, and the market disregarded for the time being the favorable items like the fair crop news, good railroad earnings, or the excellent showings for the year past made in various annual railway reports, to say nothing of further measures taken by the United States Treasury calculated to arrest any financial stringency this fall. Electric and traction stocks reflected the condition in the general market, and all suffered marked declines. On Monday of this week the stock market opened very weak and decided demoralization soon became manifest. New low records were made in many important stocks, among them being Brooklyn Rapid Transit, which fell to 29¼. General Electric recorded 136 and Metropolitan Street Railway 100. United States Steel common fell to 15 and preferred to 59¼, the previous low records of these latter two stocks being 20⅝ and 67, respectively. The pressure to sell was especially noticeable. General Electric declined 8 points on sales of 2,850 shares, presumably on reports of a reduced working force at Schenectady, and Westinghouse 13 points on sales of 700 shares. Following are the closing quotations of September 29:

NEW YORK.

	Sept. 22	Sept. 29		Sept. 22	Sept. 29
American Tel. & Cable	70	78⅜	General Electric	153	143⅛
American Tel. & Tel.	127	125⅛	Hudson River Tel.	..	..
American Dist. Tel.	24	24	Metropolitan St. Ry.	112	103¼
Brooklyn Rapid Transit	37¼	32¼	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	146	140	N. Y. & N. J. Tel.	..	140
Electric Boat	16	15	Marconi Tel.	1⅜	..
Electric Boat pfd.	40	40	Western Union Tel.	82	81
Electric Lead Reduction	1¼	1¼	Westinghouse com.	149¾	138
Electric Vehicle	4⅞	4⅝	Westinghouse pfd.	160	160
Electric Vehicle pfd.	7	7			

BOSTON.

	Sept. 22	Sept. 29		Sept. 22	Sept. 29
American Tel. & Tel	128¾	125¾	Western Tel. & Tel. pfd.	80⅛	79
Cumberland Telephone	*115⅝	*115¾	Mexican Telephone	1¾	1⅝
Edison Elec. Illum.	230	225	New England Telephone	*124	*124
General Electric	152½	142	Mass. Elec. Ry.	19	18
Western Tel. & Tel.	11¼	10	Mass. Elec Ry. pfd.	78	77

PHILADELPHIA.

	Sept. 22	Sept. 29		Sept. 22	Sept. 29
American Railways	43	42	Phila. Traction	94⅛	94
Elec. Storage Battery	52	*51⅛	Phila. Electric	8¾	5⅝
Elec. Storage Battery pfd.	..	*51⅛	Phila. Rapid Trans.	13⅜	11
Elec. Co. of America.	8¼	7⅛			

CHICAGO.

	Sept. 22	Sept. 29		Sept. 22	Sept. 29
Central Union Tel.	..	..	National Carbon pfd.	*96	*89½
Chicago Edison	..	145	Metropolitan Elev. com.	18	17
Chicago City Ry.	170	165	Union Traction	4⅛	4
Chicago Tel. Co	..	112	Union Traction pfd.	32	30
National Carbon	*20½	*20			

* Asked

BELL TELEPHONE OUTFIT.—As noted last week, the total output since December 20 last was 407,430, which although somewhat less than for the same period last year, is still larger than for any similar period in the company's history. The output and the number of instruments outstanding for the last five years are shown in the following table:

	Total outstand.	Increase.	Increase per cent.
1898	1,124,846	205,725	22.3
1899	1,580,101	455,255	40.4
1900	1,952,412	372,311	23.5
1901	2,525,606	573,194	29.3
1902	3,150,320	624,714	24.7

The increase in eight months of 1903 was 12.9 per cent, compared with 17.0 per cent. in the same eight months of 1902.

UNITED ELECTRIC SECURITIES COMPANY.—The United Electric Securities Company, in its semi-annual statement for the six months ended August 1, 1903, on the profit and loss account shows a surplus on that date of $1,032,371, against $559,979 January 31, 1903. The increase was mainly derived from a profit of $465,345 from the sale of securities. This company was incorporated May 20, 1890, under the laws of Maine. It has a paid-up capital of $1,000,000 7 per cent. preferred stock and $500,000 common stock. The company devotes itself particularly to buying mortgage bonds of corporations operating electric lighting, power and railway plants, and issuing against them its own collateral trust bonds. Since its incorporation the company has issued $10,500,000 of such bonds bearing 5 per cent. interest, of which only $1,768,000 are now outstanding, secured by collateral having an appraisal value of $2,493,443.

POWER FOR NEW YORK SUBWAY.—It is understood that the Interborough Rapid Transit Company has proposed the purchase of the surplus power of the Metropolitan Street Railway. The purchase of such power as the Metropolitan may have to spare from the operation of its own lines, will, it is expected, so far neutralize the effect of the tie-up of work on the power houses of the Interborough, due to labor troubles, as to make it possible for the subway, now nearly completed from Park Row to One Hundred and Fourth Street over the Fourth Avenue-Forty-second Street-Broadway route, to be put in operation early in the spring of next year. It would mean a gain of several months in getting some sort of rapid transit service under way, even if it were not possible for the Interborough to put on a full schedule of trains.

DIVIDENDS.—The Westinghouse Electric Manufacturing Company have declared a quarterly dividend of 2½ per cent on the preferred and the assenting and the non-assenting stocks of the company. The dividend is payable October 10. Philadelphia Company directors have declared the regular quarterly dividend of 1½ per cent. on the common stock, payable November 2.

MONTREAL STREET RAILWAY.—The directors of the Montreal Street Railway have been authorized by the stockholders to issue $1,000,000 of new stock, increasing the total amount outstanding to $7,000,000.

Commercial Intelligence.

THE WEEK IN TRADE.—A general survey of the trade situation shows that better weather and crop conditions in the Northwest have stimulated business in that section and the same applies to the South and Southwest. In the East a fair trade is reported, but quietness in general business is noted in New York, where buying power is restricted by long and costly labor troubles, and at Philadelphia, where textile business has not increased, as expected. The hardware jobbing trade in the West is reported to have been excellent. On the Pacific coast business is good as a whole. There are few complaints as to car shortage for the movement of crops. In iron and steel there has been a quieting down of demand where plans for restriction of furnace output are being discussed, and finished products lag. A number of anthracite collieries have been put on shorter time. Railway earnings' returns are still highly favorable, those roads reporting for the first half of September showing a gain of 10 per cent. over a year ago, and the absence of car congestion permits the more profitable conduct of business. Lumber and building materials are not so active at the East as was earlier expected they would be, strikes again interfering. At Philadelphia export lumber business is good, but domestic trade is quiet. It is noted that preparations for a large lumber cut in Maine and the Northwest are going forward. Pig iron is dull and weak at Chicago; finished products are unsettled and steel interests do not report orders as large as some time ago. Shutdowns of some Eastern furnaces are reported, due to moving operations, and steel sheet mills are reported likely to close if lower wages are not accepted. Structural plants are doing well, considering the restriction in consumption due to strikes. Copper was dull with little doing. It is stated, however, that consumers have limited supplies on hand and a more active market is looked for soon. The closing quotations were 13¼ to 13⅜c. for Lake; 13 to 13¼c. for electrolytic; 12¾ to 13c. for cathodes and 12⅜ to 12⅝c. for casting stock. The business failures for the week ending September 24, according to *Bradstreet's*, numbered 185, against 170 the week previous and 172 the corresponding week last year.

AMERICAN EQUIPMENT FOR BRITISH STEEL WORKS.—The Southwark Foundry and Machine Company, of Philadelphia, Pa., is about to make shipment of large blowing engines and other machinery for installation in the plant of the big British iron and steel firm of Bolckow, Vaughan & Company, Middlesboro, which is now being remodeled on American lines.

ADDITIONAL EQUIPMENT FOR CAUVERY FALLS.—The extension to the power transmission plant at Cauvery Falls, India, will be equipped with a 1,200-kw General Electric generator, direct-connected to a Pelton type water wheel of 2,000-hp capacity, built by Escher, Wyss & Co., Zurich, Switzerland.

FAN MOTORS FOR INDIA.—Sibley & Pitman, 26 Warren Street, N. Y., have fair-sized orders on hand for fan motors for shipment to India, and general supplies for the Cuban market.

EXPORT AND IMPORT TRADE.—The extent and volume of our commerce in 1903 and that of 1893 is shown by some figures just presented by the Department of Commerce and Labor, through its Bureau of Statistics. Imports have grown from $866,000,000 to $1,025,000,000, an increase of $159,000,000, and the exports have grown from $847,000,000 to $1,420,000,000, an increase of $573,000,000. They show that $92,000,000 of the increase in imports comes from Europe, $55,000,000 from Asia and about $5,000,000 each from North America, South America and Africa. The figures for Oceania show an apparent falling off of about $5,000,000, but this is due to the fact that the merchandise brought from Hawaii is no longer classed as imports, Hawaii being now a Territory of the United States. If this were included in the figures of imports in 1903 it would show a growth of imports from Oceania of about $20,000,000. On the export side the showing is equally interesting. Of the $573,000,000 of increase, $367,000,000 was to Europe, $94,000,000 to North America, $41,000,000 to Asia, $33,000,000 to Africa, $26,000,000 to Oceania, and $8,000,000 to South America. In case the shipments to Hawaii were included, the increase to Oceania would be about $36,000,000. In case those to Porto Rico were included, the increase to North America would be over $100,000,000.

ELECTRIC HEATING ORDERS.—The Prometheus Electric Company, 39 Cortlandt Street, New York, manufacturers of the well-known Prometheus electric heating and cooking apparatus and resistance units, reports a number of orders for large heating and cooking equipments, which have been received during the past few weeks. Among these might be mentioned the heating equipment for all the rooms of the steamships *Minnesota* and *Dakota*, now being built at New London for the Great Northern Steamship Company; also the entire heating equipment of the large new hat factory of F. Berg & Co., Orange Valley, N. J.; heating of the large town residence of John B. Claflin, New York; the heating of the sub-stations in Flushing, L. I.; curling iron equipments for several new New York theatres, etc. Several large agencies have also been established throughout the country, the New York agency having been given to R. H. Macy & Co., who have a large display of these goods in the basement of their store. Several new styles of apparatus have been placed on the market recently.

PLANT FOR SOUTH AFRICA.—Johannesburg is to have a very extensive electric light and power plant. The total electrical output is to be close upon 7,000 kw; but it has not been definitely decided by the consulting engineers in London, Messrs. Mordey & Dawbarn, whether steam or producer gas will be the motive power. Tenders are thus to be received for both systems. The one will include water-tube boilers with mechanical stokers, conveyors, etc., four 2,000-brake horse-power steam engines or steam turbines, each driving 1,350-kw generators, with four others of half this horse-power, one for operating a continuous dynamo and the three others for two-phase alternators. There will also be driven transformers and other gear. The units will be of the same size should gas motors be used, the internal combustion engines being simply substituted for the steam turbines or engines, and the gas-producing plant is to be equal to the gasifying of 7½ tons of Transvaal coal per hour, with all accessories of coal conveyors, etc. The contracts will be let before the end of the year.

MEXICAN CAR-BUILDING PLANT.—Construction work is about to begin on an extensive car-building plant, to be erected in Mexico City. The plant will be electrically equipped. The Mexican Car & Foundry Company has been incorporated under the Mexican laws for the purpose of building and operating the factory. Isaac M. Hutchison, of Mexico City, who represents the interests of the St. Louis Car Company, A. L. Ide & Sons, and other prominent American manufacturing concerns in the southern republic, is the leading spirit in the enterprise. The united capacity of the plant will be 20 cars daily. Later on electric traction cars will be turned out at the rate of a score a month. The works will have an independent power and lighting plant, whose capacity will in the first instance be 500 hp. Contracts for the electrical equipment, also for machine tools, etc., will be awarded within the next three weeks.

GENERAL ELECTRIC ROTARY CONVERTERS FOR SYDNEY TRACTION SYSTEM.—The General Electric Company has been awarded a further contract by the New South Wales Railroad Commission for the sub-stations of the Sydney City & Suburban electric traction system. The contract calls for two additional sub-station equipments consisting of 450-kw rotary converters, with the necessary transformers to convert from 6,600 to 600 volts. Five more units for installation in various sub-stations, consisting of three-phase rotary converters of 400-kw capacity each, with the necessary transformers and other machinery are also about to be ordered.

ELECTRICAL POWER PLANT FOR VENEZUELA.—Senor Antonio Para, of Caracas, Venezuela, who has been in this country for several weeks negotiating several fine beds of asphalt, which he holds under government concession on the Island of Trinidad, has received instructions to sail for home before October 1 and bring with him plans and estimates for a complete government electrical power plant, presumably for the government army supply factory and arsenal. He has already received plans and estimates from several concerns in this country for the equipment of a complete electrical system of asphalt conveying machinery for the mines in Trinidad.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, manufacturer of the "Chloride" accumulator, has, within a few days, closed contracts with the New York Edison Company and the Chicago Edison Company for additional batteries. These are in addition to the installations mentioned in a recent issue. The battery for the New York Edison Company consists of 150 cells, with a capacity of 4,480 amp.-hours, and makes the twenty-third installation for this company. The battery for the Chicago Edison Company makes the fourteenth battery operated by this company, and has a capacity of 2,813 kw-hours.

BRAZILIAN TRACTION PROJECT.—An electric traction system is to be built between the city of Rio Janeiro and Nictheroy, once the capital city of Brazil. The length of the road will be about five miles. It will be a metric gauge line. Dr. Carlos Cesar de Oliveira Sampaio and Antoni Julio de Oliveira Sampaio have secured the concession for the construction and operation of the system. Among the provisions of the franchise is the exemption from import duties of the material, etc., for the construction of the road and for the first three years of its working.

ANDERSON LINE MATERIAL.—The Albert and J. M. Anderson Manufacturing Company, of Boston, has lately taken a number of good-sized British orders for line material through Robert W. Blackwell & Company, Limited, of London. Orders are also in hand from Francis J. Cundill, for the British firm of L. J. Healing & Co., of Yokohama, Japan. Domestic orders received within the last few days include one from the Union Railway Company, of New York, for line material to be used in the construction of the Macombs Dam Bridge line and other extensions.

SKINNER ENGINE ORDERS.—J. Holt Gates, Monadnock Building, Chicago, western agent of the Skinner Engine Company, Erie, Pa., reports the following sales of engines: Wisconsin Bridge and Iron Company, 150-hp direct-connected; Ingersoll Milling Machine Company, Rockford, Ill., 150-hp, direct-connected; La Crosse Cooperage Company, La Crosse, Wis., 125-hp, belted; Granada Hotel, Chicago, 2 direct-connected sets; Clinton Brewing Company, Clinton, Ia., 60-hp, direct-connected set; Mueller Brewing Company, 125-hp, direct-connected.

STEEL POLES.—The Franklin Rolling Mill & Foundry Company, of Franklin, Pa., which concern is represented in New York by Chas. W. Mackey, Postal Telegraph Building, is completing its plant for the manufacture of steel poles for electric light, power, trolley, telephone and telegraph lines, and is making a bid for foreign business. Arrangements have been made with Roger Sons & Company, of London, to represent the company in Great Britain, while Isaac M. Hutchison, Mexico City, who represents the interests in Mexico of the St. Louis Car Company, will handle the poles there.

ROCHE BATTERIES FOR ABROAD.—William Roche, 42 Vesey Street, New York, reports recent receipt of several substantial foreign orders for his standard dry batteries. The more important orders have been secured from London, through the export house of S. Hoffnung & Company, Limited, 116 Broad Street, and for South Africa, China and Australia through Muller, McLean & Company, same address.

LAUNCHES FOR ST. LOUIS FAIR.—The Willard Storage Battery Company, of Cleveland, Ohio, has closed a contract with the Truscott Boat Manufacturing Company, of St. Joseph, Mich., for 31 sets of battery of 44 cells each. These batteries are to be used for operating launches at the Louisiana Purchase Exposition, at St. Louis. They will have a capacity of 140 amp.

ORDER FOR AKRON GENERATORS.—The Mantua Light, Heat and Power Company, of Mantua, Ohio, has closed contract with the Bosworth-Holding Company, Cleveland, agent for the Akron Electrical Manufacturing Company for two generators. The plant will be in operation in about two months.

"PHONO" WIRE FOR EUROPE.—The Bridgeport (Conn.) Brass Company has recently secured some fair-sized contracts for Phono electric wire, through the British electrical engineering and contracting firm of Maguire & Barcus, for use by English and German electric traction systems.

SUPPLIES FOR MEXICO.—The Trumble Electric Manufacturing Company, Plainville, Conn., has secured a fair-sized contract through its New York office, T. D. Watson, manager, from the export house of Carr Brothers, 61 Broadway. The goods will be shipped to Mexico.

BALL ENGINE ORDER.—Crofts & Reed, manufacturers of soaps and perfumes, Chicago, Ill., have purchased a 200-hp, direct-connected engine from the Ball Engine Company, Erie, Pa.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

American Electrochemical Society. Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa.

American Electro-Therapeutic Association. Secretary, Dr. C. E. Skinner, New Haven, Conn.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty Street, New York.

American Railway, Mechanical & Electrical Association. Secretary, Walter Mower, 12 Woodward Ave., Detroit, Mich.

American Street Railway Association. Secretary, T. C. Pennington, 2020 State Street, Chicago.

Association of Edison Illuminating Companies. Secretary, W. H. Johnson, Philadelphia, Pa.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, Indianapolis, Ind., June 15, 1904.

California Street Railway Association. Secretary, J. E. Morris, Oakland, Cal.

Canadian Electrical Association. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Hamilton, Ont., 1904.

Connecticut State Street Railway Association. Secretary, A. E. Pond, New Haven, Conn.

Engine Builders' Association of the United States. Secretary, F. P. Ide, Springfield, Ill. Next meeting, December, 1903. Date and place to be announced later.

Electrical Trades Society (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets second Friday of each month.

Illinois State Electric Association. Secretary, H. E. Chubbuck, LaSalle Ill.

Indiana Electrical Association. Secretary, H. C. Kimbrough, Muncie, Ind.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y.

Interstate Independent Telephone Association. Secretary, E. M. Coleman, Louisville, Ky. Next meeting, Chicago, Ill., December 8, 9 and 10, 1903.

Iowa Telephone Association. Secretary, C. C. Deering, Des Moines, Ia. Annual meeting, Des Moines, March 8, 1904.

Kentucky Independent Telephone Association. Secretary, H. K. Cole, Lancaster, Ky.

Maine Street Railway Association. Secretary, E. A. Newman, 71 Congress Street, Portland, Me.

Magnetic Club, New York, N. Y. Secretary, R. J. Murphy, 195 Broadway, New York City. Annual meeting, Second Thursday in January; meetings, April, June and November.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass.

Michigan Interurban and Street Railway Association. Secretary, Benjamin S. Hanchett, Jr., Grand Rapids, Mich.

National Arm, Pin & Bracket Association. Secretary J. B. Magers, Madison, Ind.

National Independent Telephone Association. Secretary, Frank G. Jones.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting St. Louis, Mo., September 14, 15 and 16, 1904.

New England Street Railway Club. Secretary, J. H. Neal, 101 Milk Street, Boston, Mass.

New York Electrical Society. Secretary, G. H. Guy, 114 Liberty Street, New York.

National Electric Light Association. Secretary, Ernest H. Davis, Williamsport, Pa. Next meeting, Boston, Mass., May or June, 1904.

Northwestern Electrical Association. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis. Next meeting, Milwaukee, Wis., Jan. 20, 1904.

Ohio Street Railway Association. Secretary, Chas. Currie, Akron, Ohio.

Ohio Electric Light Association. Secretary, J. H. Perkins, Youngstown, Ohio. Next meeting, Columbus, Ohio, October 13, 14 and 15, 1903.

Old Time Telegraphers' & Historical Association and Society of United States Military Corps. Secretary, John Brant, 195 Broadway, New York.

Pennsylvania Street Railway Association. Secretary, Charles H. Smith, Lebanon, Pa.

Southern Indiana Telephone Association. Secretary, E. W. Pichardt, Huntingburg, Ind.

Southwestern Electrical Association. Secretary, G. W. Cooper, Oklahoma City, Okla. First Semi-Annual meeting, Oklahoma City, October 9 and 10, 1903.

Southwestern Gas, Electric & Street Railway Association. Secretary, Frank E. Scoyill, Austin, Texas.

Street Railway Accountants' Association of America. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y.

Street Railway Association of the State of New York. Secretary, Henry A. Robinson, 621 Broadway, New York. Next meeting, Syracuse, N. Y., October 6 and 7, 1903.

Tennessee Street Railway Association.

Toronto (Canada) Railway Roadmasters' Association. Secretary, John F. Argue, Janes Building, Toronto, Ont.

United Electrical Contractors' Association of New York State. Secretary, William J. Davis, Ithaca, N. Y. Next meeting, New York City, January 19, 1904.

Vermont Electrical Association. Secretary, C. C. Wells, Middlebury, Vt.

Virginia Street Railway and Electric Association. President, R. P. Apperson, Lynchburg, Va.

General News.

THE TELEPHONE.

NEWPORT, ARK.—The Farmers' Telephone Company has been organized here with a capital stock of $100,000. The old Newport-Elgin line has been absorbed by the new company. A line from Elgin to Centerville and other places will be constructed in the near future.

SAN BERNARDINO, CAL.—The directors of the Home Telephone Company have authorized an issue of $100,000 bonds for the purpose of building its plant.

HAWKINSVILLE, GA.—The Southern Bell Telephone Company will build a line from Macon to Cochran.

SAVANNAH, GA.—Contracts have been signed by the following telephone companies by which the chief cities of Georgia and Alabama will be connected by long distance lines. The Southern Long Distance Telephone Company and the Georgia Telephone & Telegraph Company of Savannah, and the Atlanta Telephone & Telegraph Company. A charter will soon be applied for by John Flanney, W. A. Bisbee and others of Savannah.

MOLINE, ILL.—The Union Electric Telephone Company will build a line from here to Milan.

CHAMPAIGN, ILL.—The Home Telephone Company has been organized here with a capital stock of $3,000.

SUMNER, ILL.—The Farmers' Mutual Telephone Company has applied to the council of this place for a franchise.

CHARLESTOWN, IND.—The Home Telephone Company has been granted a franchise to enter Charlestown.

DANVILLE, IND.—The name of the Plainfield Telephone Company has been changed to Consolidated Telephone Company, with principal office in Danville.

CRAWFORDSVILLE, IND.—The Co-operative Telephone Company, of this city, has filed the required bond and received authority to make desired changes and extensions of its lines.

LINTON, IND.—The Home Telephone Company of Linton is reconstructing its entire line and plant and will erect its own exchange building. The company proposes extending its lines to the numerous coal mines in the county.

EVANSVILLE, IND.—The citizens of Evansville are not in accord concerning the installation of a municipal telephone system until it is ascertained that there will not be a dual system. One "company and regulate it," is the slogan.

WABASH, IND.—City Clerk McLees has, by order of the council, notified the Central Union Telephone Company to remove its poles, wires and property from the streets by October 1. The company's franchise expired some weeks ago and no effort is being made to procure a new franchise.

YEOMAN, IND.—The Yeoman Telephone Company has filed articles of incorporation with the Secretary of State. This new company will build an exchange in Yeoman, construct and operate telephones and telephone lines throughout Carroll and White counties. Wm. M. McNeel is president; C. W. Steel, secretary; M. M. Baum, Wilbur Creek and G. M. Briney, directors.

GOSHEN, IND.—The State Board of Tax Commissioners have fixed assessments of telephone companies in Elkhart County as follows: American, 876.67 miles at $50 per mile, $43,833.50; Central Union, 935.25 miles at $56 per mile, $52,374.00; United States, 47 miles at $40 per mile, $1,180; Home, 460 miles at $160 per mile, $72,240; Syracuse Home, 22 miles at $10 per mile, $220; Wakarusa Home, 70 miles at $30 per mile, $2,100.

INDIANAPOLIS, IND.—A recent census of the independent telephones in this state shows that independent lines and exchanges are well established in eighty counties and partially established in the remaining twelve counties. Only two counties in the state, Clark and Vanderburg, are without independent telephone exchanges. There are 109,000 independent telephones in operation in the state. In Indianapolis the New Telephone Company has 7,536 telephones in operation and 800 applicants waiting by turn the arrival of instruments and material which cannot be procured as rapidly as needed.

KELLOGG, IA.—The Kellogg Mutual Telephone Company has been organized by C. T. Powers, H. Thorpe, Frank Coffee and others.

NEWTON, IA.—The Jasper County Telephone Company will increase its capital stock from $100,000 to $150,000, to take over six additional lines which have been lately organized.

PORTSMOUTH, IA.—The Portsmouth Telephone Company has been incorporated with a capital stock of $10,000. The officers are: President, Gus Batty; vice-president, Peter Korth; secretary, W. A. Sorrenson; treasurer, C. S. Scroggins.

KEOKUK, IA.—The Union Telephone & Telegraph Company has been incorporated with a capital stock of $1,500. Mr. J. C. Hubinger is one of the promoters of the company, which will operate telephone and telegraph lines in Iowa, Minnesota, Illinois, Missouri and other states.

WINFIELD, KAN.—The Winfield Telephone Company operates exchanges in this place and at Oxford. The Winfield board has a capacity of 600 drops, and that at Oxford has 50 drops, the number of subscribers being 570 and 44, respectively. Ericsson apparatus is used exclusively. The company has 100 miles of toll line.

FRANKFORT, KY.—The Rural Home Telephone Company of Daviess County, with a capital stock of $25,000, and the Whitley Telephone Company, with a capital stock of $4,000, have been incorporated.

UNION, ME.—The Union Telephone Company has 45 subscribers and 40 miles of toll line. It uses apparatus of the American Electric Telephone Company, the switchboard being of 25 drops capacity. The rates for toll service are $20, $15 and $12. Mr. F. A. Burkett is clerk.

ADRIAN, MICH.—The South Dover Telephone Company has been incorporated, the capital stock being $1,000.

HOMER, MICH.—The Woodbury Telephone Company of this city will build several extensions to its system during the fall.

BURR OAK, MICH.—The capital stock of the A. C. Himebaugh Telephone Company was lately increased to $60,000. The growth of the company rendered the additional capitalization necessary.

SOUTH LYONS, MICH.—The South Lyons Telephone Company has been organized by ten business men of this place, Mr. Kingsley Calkins being president. An independent exchange will be established here.

DULUTH, MINN.—The Mesaba Telephone Company will extend its line from Hibbing to Nashwauk, a distance of 15 miles. Nashwauk is a new town on the Mesaba range.

PARIS, MO.—The Monroe County Mutual Telephone Company of Paris, with a capital stock of $4,500 has been incorporated by W. Jones, W. S. Wiley, J. M. Grigsley and others.

LINCOLN, NEB.—The Monroe Independent Telephone Company, with an authorized capital stock of $5,000, has filed articles of incorporation.

CLYDE, N. Y.—The Empire State Telephone & Telegraph Company is building a trunk line from this city to Wolcott.

ELMA, N. Y.—The Elma Telephone Exchange has been organized with a capital stock of $5,000. The incorporators are Herman Judge, R. Peter Lee and Herbert B. Lee.

NEW YORK, N. Y.—It is stated that the Police Department of New York City has contracted with the New York Telephone Company for an exclusive telephone system. The contract calls for 661 telephones, the entire plant to cost between $400,000 and $500,000.

BAINBRIDGE, N. Y.—The Bainbridge Telephone Company has 100 subscribers, mostly all farmers, each subscriber being a stockholder. The company has about 25 miles of line, and charges 10 cents per message to those not subscribers. It uses Stromberg-Carlson apparatus.

DELHI, N. Y.—The Delhi Telephone Company's business is rapidly expanding. It now has 250 subscribers and 75 miles of toll line. Its switchboard capacity is 200 drops. The rate for toll service is $10 per year. The company uses Standard Telephone Company apparatus.

PENN YAN, N. Y.—The Milo Telephone Company has been organized at Second Milo with a capital stock of $5,000. The directors elected the following named officers: President, A. Castner Townsend; vice-president, John A. Stone; secretary and treasurer, John W. Coolbaugh. This company will be connected with the switchboard of the Inter-Ocean Telephone Company at Penn Yan.

WAXHAW, N. C.—The Waxhaw Telephone Company, of Union County, N. C., has been chartered, its capital stock being $2,000.

CALEDONIA, OHIO.—The Marion County Telephone Company is putting in an exchange here.

SALEM, OHIO.—The business men of Salem have organized to resist the purpose of the Columbiana County Telephone Company to increase its rates.

PLATSBURG, OHIO.—The Home Telephone Company of Platsburg is building a line to Catawba and will extend throughout the county.

WARREN, OHIO.—The Burton Telephone Company is extending its line from Middlefield to Mesopotamia.

DILLONVALE, OHIO.—The Vigilent Telephone Company has been incorporated with $3,000 capital stock by J. L. Barkhurst, H. T. Roe and others of Dillonvale.

McCOMB, OHIO.—The Farmers' Mutual Telephone Company is constructing a telephone line between McComb and Benton Ridge. It is planning to build other lines.

HOLMSVILLE, OHIO.—Judge F. G. Robinson, of Ravenna, has refused an injunction restraining the Columbiana County Telephone Company from increasing its rates for service.

WAPAKONETA, OHIO.—The Buckland Mutual Telephone Company has been organized with H. D. Bowsher, president; R. W. Sharp, vice-president; T. E. Bowsher, secretary-treasurer.

TOLEDO, OHIO.—The Wellsburg Home Telephone Company of West Virginia has been permitted to conduct business in Ohio. It will locate at Toledo. The capital stock is $50,000.

PORT CLINTON, OHIO.—The Ottawa County Telephone Company is extending its system to all the farmers in this district. The company has recently completed direct connection with Toledo.

ORRVILLE, OHIO.—The Millersburg, Wooster & Orrville Telephone Company is preparing to rebuild its plant at Orrville. About 100 poles will be replaced and 9,000 feet of cable will be put up.

KIMBLE, OHIO.—The Farmers' Telephone Company has been organized here with a capital stock of $5,000, by L. P. Wirtz, S. S. Fraizer, Geo. W. Weidner, G. W. and P. O. Stiving and W. J. Ewing.

ELYRIA, OHIO.—The Elyria Telephone Company has increased its capital stock to $50,000 and has purchased property on which it will erect a new building to be equipped with a modern board of 2,000 lines capacity.

WAPAKONETA, OHIO.—The Wapakoneta Telephone Company is making arrangements to enlarge its exchange and will shortly place a switchboard extension. The company now has over 400 subscribers and its business is growing rapidly.

NEW PHILADELPHIA, OHIO.—The Crescent Telephone Company is erecting new lines between here and Browerstown and will extend to Sherodsville and New Hagerstown. It will connect with all the surrounding towns in the county in the near future.

UPPER SANDUSKY, OHIO.—The Upper Sandusky Telephone Company has elected G. W. Hale, president; L. D. Ingard, vice-president; M. H. Brinkerhoff, secretary; J. J. Hulse, treasurer, and C. C. Juvenal, manager. The company has added 125 new telephones within a year.

SPRINGFIELD, OHIO.—The Springfield & Xenia Company is completing its exchange in Springfield and it will be in operation within a few days. The United States Telephone Company has built a long distance line into Springfield to afford long distance connection for the new exchange.

RAVENNA, OHIO.—The Portage County Telephone Company, which was organized six months ago, is making a remarkable showing. It has increased the number of its subscribers by 300 and has entirely rebuilt the system in Ravenna. It is building several miles of toll line in the surrounding country.

TOLEDO, OHIO.—City Solicitor Denman has submitted an opinion to the City Council that the Toledo Home Telephone Company may legally charge its patrons an arbitrary rate regardless of franchise restrictions. He holds that it may also cease to provide free telephones for city use and may prohibit the city from using its poles for carrying fire alarm wires.

CINCINNATI, OHIO.—The Philip Fitzsimmons Telephone Mfg. Company has been reorganized here, the capital stock being increased from $5,000 to $6,000,000. Mr. Fitzsimmons is president of the company and Mr. W. C. Prickett is vice-president and general manager. This is the company through which the Hamilton Telephone Company expects to reach Cincinnati.

SALEM, OHIO.—A local mercantile firm has brought suit against the Columbiana County Telephone Company to test its right to advance its rates over those stipulated in its franchise from the city. The company refused to put in a telephone at the old rate; hence the suit. It maintains that the courts have decided that a municipality has no right to establish rates for telephone service.

OKLAHOMA CITY, OKLA.—The Missouri & Kansas Telephone Company will expend $40,000 in the construction of a conduit system here.

PITTSBURG, PA.—The Ronceverte & Elkins Telephone Company has been incorporated by S. J. Payne and others. The capital stock is $10,000.

BEAVER, PA.—The Beaver County Telephone Company has been incorporated with a capital stock of $100,000. The directors are J. G. Mitchell, J. A. Mellor and H. M. Camp.

NEW BETHLEHEM, PA.—West Millville Telephone Company uses an American "Express" switchboard of 60 drops, has 50 miles of toll lines and 60 subscribers. Service costs $2 per month.

WASHINGTON, PA.—The Federal Telephone Company is securing rights of way for a line from Waynesburg to Dallas, W. Va., there to meet a line already constructed from that place to Wheeling.

NAZARETH, PA.—The magneto system is used in the exchanges of the Slate Belt Telephone & Telegraph Company, with branches at Nazareth, Bangor, Pen Argyl and Portland, Pa. The latter is a recent addition; a new switchboard has also been installed at Bath, Pa. A 500-drop Kellogg switchboard is used in the service furnished 600 subscribers, who pay $18 and $24 yearly. The Slate Belt Company has toll connections with the Keystone Company of Philadelphia and the Consolidated Telephone Company.

AIKEN, S. C.—The South Carolina Long Distance Telephone Company is rebuilding the local system in Aiken.

ABERDEEN, S. D.—At the annual meeting of the Dakota Central Telephone Company the old officers were re-elected. The company now has 3,000 miles of lines in operation, and many extensions and improvements are projected.

WARRENTON, TEX.—The Commercial Telephone Company of Houston is building a line between Carmine and Lagrange, and extensions to other places are contemplated.

WYTHEVILLE, VA.—The capacity of the Wytheville Telephone Company's exchange has been doubled in the past two years; at present there are 300 subscribers, who pay a flat rate of $15 per annum.

LEXINGTON, VA.—The Lexington Mutual Telephone Company, with its 150 subscribers and 20 miles of toll line, reports the outlook as fair and says it may make the system metallic. American Electric telephone apparatus for the most part is used.

SPOKANE, WASH.—The Interstate Telephone Company, incorporated with a capitalization of $100,000, will make connection between this city and towns in Northern Idaho. The officers of the new company are M. A. Phelps, of Spokane, president and treasurer; John Fisher, of St. Maries, vice-president and manager; P. W. Haverland, of St. Maries, secretary. The company has under contemplation many extensions in its lines.

FOUNTAIN CITY, WIS.—D. S. Schroeder is promoting a new telephone system here.

SCANDINAVIA, WIS.—The Scandinavia Telephone Company will install an exchange here.

KNAPP, WIS.—The Knapp Telephone Company has been incorporated with a capital stock of $5,000.

ALGOMA, WIS.—The Farmers' Lake Shore Telephone, Traction & Electric Power Company has incorporated with a capital stock of $3,000. Dan Hitt is one of the directors.

GREEN BAY, WIS.—The Valley Telephone & Telegraph Company has been organized here. Dr. W. E. Fairfield is president; H. H. Davenport, of Chicago, secretary, and W. H. Jones, of Chicago, treasurer. The company will build an independent system in this city.

LARAMIE, WYO.—A telephone system will be built between this city and Hanna by way of Rock River. The distance to be covered is 75 miles, and a number of big ranches will be included in the line.

MACON, GA.—A new telephone system may be established here by A. W. Zealey and David Goldberg, who have petitioned the council for a franchise.

JACKSON, GA.—It is the intention of the Jackson Telephone Exchange to build 22 miles of toll line to extend its system. It has at present 182 subscribers.

SYLVANIA, GA.—Of the 85 subscribers in the system of the Creven Telephone Company 25 were added this year. A 50-drop switchboard of the Telephone Manufacturing Company's make is used. The rates are from $1 to $2.50 per month.

TIFTON, GA.—Mr. J. J. L. Phillips, president of the Tifton Telephone Exchange, reports a good outlook with a contemplated increase of 20 telephones. A Stromberg-Carlson 200-drop switchboard is used for the 150 subscribers, who pay $1.25 for residence and $2.50 for business service.

WASHINGTON, GA.—The Washington Telephone Company which operates in Wilkes County, has 110 subscribers. Apparatus manufactured by Sumter Telephone Manufacturing Company and Telephone Manufacturing Company is used. The rate for toll service is 15c. for five minutes, 20 miles.

PASCHAL, GA.—The Union Telephone & Electric Light Company operates three exchanges. At Buena Vista the switchboard has a capacity of 135 drops, at Talbotton 165 and at Montezuma 125. There are 425 subscribers who pay $1 to $2.50 per month. The company reports a good outlook, and is contemplating an increase of from 50 to 100 subscribers.

FOREST CITY, ILL.—The Forest City Telephone Company has increased its capital stock from $5,000 to $20,000.

STEWARDSON, ILL.—The capital stock of the Stewardson Telephone Company has been increased from $2,500 to $5,000.

HOPEDALE, ILL.—H. G. Schneider, with others, has incorporated the Farmers' Telephone Company, with a capital stock of $5,000.

CHICAGO, ILL.—The capital stock of the Norstrom Lockout Telephone & Manufacturing Company has been increased from $6,000 to $10,000.

ALEXIS, ILL.—The Alexis Telephone Company has been incorporated to operate telephone exchanges; capital stock, $2,000. Incorporators: Charles Rogers, J. W. Standley and W. A. McKnight.

BETHANY, ILL.—Mr. W. S. Herman, proprietor of the telephone line at Bethany reports that he is constantly extending his service. Of the 156 subscribers about forty have been added this year.

ALPHA, ILL.—The Cox Telephone Exchange operates a 112-drop Stromberg-Carlson switchboard, has 200 subscribers, 175 miles of toll line, and charges $3 per year for service. Each subscriber owns his line.

TAMPICO, ILL.—The Tampico Farmers' Mutual Telephone Company has thirty miles of line and connects with other farmer companies throughout Whiteside and Bureau counties. The company will extend its lines to Deer Grove.

COLUMBIA CITY, IND.—The Farmers' Mutual Telephone Company has been incorporated with a capital of $25,000. R. R. Scott is one of the directors.

LIBERTY, IND.—The Liberty Telephone Company, formerly owned by Drs. Coughlin and Wilson, of Indianapolis, has been incorporated as a stock company with a capital stock of $30,000. The company will build new country lines and install a new 400-drop switchboard.

LAWRENCEVILLE, IND.—The Farmers' Home Mutual Telephone Company of Lawrence County has been granted a thirty-year's franchise by the Lawrenceville City Council. The company is installing a modern system and extending the service to many towns in Lawrence County.

MOORELAND, IND.—The Mooreland Rural Telephone Company contemplates building a few party lines, about five miles, immediately. It will have 200 telephones in a short time. A 100-drop "Eureka" switchboard is in use. There are at present 158 subscribers, and 20 miles of toll line.

BROWNSTOWN, IND.—At a recent meeting of the representatives of the Seymour Telephone Company, the Zollman, Trautman and Ruddick lines, and the Brownstown Telephone Company, arrangements were made whereby a long-distance line will be built and operated from Bedford to Seymour by way of Brownstown and Medona.

INDIANAPOLIS, IND.—The Farmers' Mutual Telephone Company of Columbia City has filed articles of incorporation with the Secretary of State. The company has a paid up capital stock of $2,500. The principal exchange and offices will be in Columbia City. The officers are: President, Robert S. Scott; vice-president, C. R. Stoner; secretary, D. W. Dranfee.

INDIANAPOLIS, IND.—From recent developments there are reasons to believe that the independent telephone system of Indiana will soon gain admission into Cincinnati, Ohio. The arrangements made recently by representatives of the New Long Distance Telephone Company of Indiana and the United States Telephone Company of Indiana, to build and connect up what is to be known as the Indiana-Ohio system will practically accomplish this result, as the United States Company has instruments in operation just outside the city limits. It is claimed that plans are maturing whereby Cincinnati will be included among the large number of towns and cities served by the independent systems.

NASHVILLE, IND.—After standing out and denying themselves of telephone service for three months in the hope of getting better terms, the citizens of Nashville have ordered the telephones replaced in their homes and business houses. Several months ago the Morgantown Telephone Company put in an exchange at Nashville, the first system the city ever had. After a time a large number of patrons demanded a lower rate for communicating with Columbus, this being denied, the telephones were ordered out by physicians, merchants, county officers and others. The company remained stubborn and the citizens have now yielded by declaring that the telephone is too much of a necessity to do without, and have withdrawn further opposition to the company's rate and ask for the restoration of their instruments.

CASSELTON, IA.—The Hunter Telephone Company has been organized with a capital stock of $5,000.

NEWHALL, IA.—Mr. James Harrington is president of the Farmers' & Merchants' Mutual Telephone Company, just incorporated with a capital stock of $1,600.

CEDAR FALLS, IA.—The Iowa Telephone Company will rebuild its exchange throughout, installing a central energy board and introducing other improvements.

COKATO, MINN.—The Cokato Telephone Company has been incorporated with $10,000 capital.

NORTHFIELD, MINN.—The Cass County Telephone Company has been organized to build a line from Leader to Motley.

CYRUS, MINN.—The Stevens County Telephone Company started business July 20 this year. It has a switchboard capacity of fifty drops and twenty subscribers. It operates 25 miles of toll line and its rates are $1.50 and $1 per month. The officers are H. L. Hulburd, president; C. R. C. Johnson, secretary and treasurer, and Z. Burt Clarke, superintendent.

ST. LOUIS, MO.—At a meeting of the stockholders of the new St. Louis County Telephone Company the following named officers were elected: J. B. C. Lucas, president; F. A. Heidorn, vice-president; D. C. Taylor, secretary; Ernest Marshall, treasurer, and James D. Houseman, general manager.

RED LEDGE, MONT.—The Rocky Mountain Bell Telephone Company has been granted permission to establish a toll line in this city. The council stood firm in favor of giving the exclusive telephone privilege to L. L. Moffit, until the latter sold his Wyoming exchanges to the Bell Company, thereby leaving Red Lodge without connection except over the Bell lines. The Bell Company has agreed to pay the expenses of a special election and to pay one-half of the $2,000 fines assessed in the city police court against the Bell Company's linemen. The special election will be held within two or three weeks.

WINSTON, N. C.—The Bell Telephone Company will string an additional circuit between Greensboro and Winston.

BENSON, N. C.—The Benson Telephone Company of Johnston County has been chartered with a capital of $10,000.

YANCEYVILLE, N. C.—The Yanceyville Telephone Company, of Yanceyville, has been chartered to build several long distance lines. B. S. Graves, of Yanceyville, is interested.

FESSENDEN, N. D.—C. E. Leslie and others were granted a franchise by the county board to build telephone lines.

TROY, OHIO.—The Bushnell telephone line will be extended to Pleasant Hill.

GREENWICH, OHIO.—The Clinton Telephone Company has secured a franchise in this place and will soon commence work on an exchange.

CINCINNATI, OHIO.—The City & Suburban Telegraph Association has signed a contract for connection with the Independent Telephone Company of Kenton County (Kentucky).

FREMONT, OHIO.—The Fremont Home Telephone Company has increased its capital stock from $60,000 to $100,000 and is planning to make improvements. Russ J. Christy is secretary.

SALEM, OHIO.—The Salem Business Association, composed of a number of leading business men, has adopted a resolution deciding to use the Bell telephone. The Columbiana County Telephone Company, the independent company, recently increased its rates, resulting in concerted action against it.

EAST LIVERPOOL, OHIO.—The business men's associations of Lisbon, Leetonia, Columbiana and East Liverpool have adopted resolutions to fight the increase in rates announced by the Columbiana County Telephone Company which operates in all these towns. The telephone company claims to have lost $60,000 in the past three years.

AKRON, OHIO.—The Summit Rural Telephone Company, recently incorporated with $3,000 capital stock, has bought at receiver's sale the property of the Copley-Sharon Telephone Company and will rebuild the lines and improve the service. New toll stations will be installed at Montrose, Ghent and Hammond's Corners. Connection will be made with the Akron People's Telephone Company, thus securing long distance service.

BLACKWELL, OKLA.—The Blackwell Rural Telephone Company has been incorporated by William Risley and others, the capital stock being $25,000.

PIEDMONT, S. C.—On account of an increase in rates a fight is on here against the Southern Bell Telephone Company.

DALLAS, TEX.—Joseph D. Lloyd, of Wilkesbarre, Pa., has made application to the city authorities here for a franchise for the construction and operation of an independent telephone system in Dallas. He represents independent telephone interests which comprise the Fort Worth Telephone Company. Mr. Lloyd is secretary and treasurer of the latter company.

FARMVILLE, VA.—The South Side Telephone Company, recently organized in this city, has commenced the construction of its system in Prince Edward and Cumberland counties. The officers of the company are: Dr. Peter Winston, president; J. D. Eggleson, vice-president and general manager, and E. W. Venable, secretary.

WASHBURN, WIS.—The Bayfield County Telephone Company has just been organized in connection with the Home Telephone Company of Ashland, and lines have been strung between Ashland, Washburn, Iron River, Mellen and other points. The lines will be carried through to Bayfield at once, and then connection will be made with all Northern Wisconsin and long distance points.

OTTAWA, ONT.—The Bell Telephone Company has made a proposition to the city of Ottawa, in return for a five years' monopoly of the telephone service of the city, to give a service at the rate of $25 per annum for residential telephones and $45 for business telephones. The company will also give free service to the civic buildings and other concessions. The city council is considering whether to accept this proposal or install a municipal telephone service.

ELECTRIC LIGHT AND POWER.

DADEVILLE, ALA.—It was voted on Sept. 21 to issue $10,000 bonds for an electric light plant.

BENSON, ARIZ.—A great electric generating plant is to be established at the falls in the Colorado River, 25 miles below the Grand Canyon, by the Minnesota Gold Mining Company. C. T. English, of St. Paul, Minn., is engineer. More than 25,000-hp will be developed.

WATSEKA, ILL.—The Council has granted Frank Bartness & Company a franchise for an electric light plant.

CARBONDALE, ILL.—The Carbondale Water, Light & Power Company is the outcome of the consolidation of the various companies operating in that city, capital $200,000.

WEST LEBANON, IND.—The City Council has granted a franchise to Wm. H. Goodwine for an electric light plant, to run for twenty years. The plant is to be constructed at once.

CRAWFORDSVILLE, IND.—The report of the electric light commissioners shows that during the month of August the receipts of the plant were $625 and the disbursements $2,506.44.

RUSHVILLE, IND.—The City Council will improve the electric light plant by putting in all new machinery, changing old building, etc. Plans will also be made for buying additional machinery. A. L. Stewart is now preparing the plans and specifications.

ELWOOD, IND.—City officials are holding back bills of the Elwood Electric Light Company pending investigation of a charge that the company is not furnishing light of the required candle power. They insist that the plant be overhauled and modern machinery be installed.

INDIANAPOLIS, IND.—The Merchants' Association has adopted resolutions in favor of an all-night schedule for electric lights in this city under the proposed new contract. The specifications provide for an all-night schedule, but the moonlight schedule is also provided for, so bidders are requested to make proposals on both systems.

VINCENNES, IND.—The City Electric Lighting Company has asked the City Council for a twenty-year's extension of its franchise without change in the price of lighting. It asserts that the company contemplates expending a large sum of money in making extensions and improvements and the installation of new and up-to-date machinery, but the outlay could not be justified on the life of the present franchise.

FT. WAYNE, IND.—A peculiar condition exists in this city. The Jenney Electric Light Company asked for a renewal of its franchise. The company is now furnishing the municipal and commercial lighting. Mr. R. Woodworth and others secured a temporary injunction against the council restraining it from granting the franchise. Woodworth and his associates are in favor of the erection of a municipal plant, and say that the granting of the franchise would put this out of the question. A change of venue has been taken to Auburn. In the meantime a company of citizens have agreed to build the city an electric light plant which will furnish street lights for $70 a year and charge 10 cents per kw-hour for commercial uses. The plant is to become the property of the city in ten years, the city paying over to the company the $60,000 which has been raised by taxation for a municipal plant.

MINDEN, IA.—There is an opening here for an electric light plant.

PORTLAND, ME.—The Steep Falls Lighting Company has been organized at Portland, for the purpose of manufacturing electricity for light, heat and power purposes; capital, $10,000. Guy H. Sturgis, president, Steep Falls; Franklin B. Pease, treasurer, Portland.

MILLERS FALLS, MASS.—Sargent, Conant & Co., Boston, will soon begin work on an electric light and power plant for the town of Millers Falls.

GREENFIELD, MASS.—The State Gas & Electric Light Commissioners have authorized the Greenfield Electric Light & Power Co. to issue $100,000 bonds, $75,000 of which is for the construction of a new plant on Deerfield River.

MANCHESTER, MASS.—The Manchester Electric Company expects to put in conduits and wires for light and power, build a small distributing station, and buy current from the Beverly Electric Company. The General Electric Company will probably receive the contract.

LAWRENCE, MICH.—The question of issuing $25,000 water and light bonds is under consideration.

ALPENA, MICH.—A vote will be taken on the question of issuing $100,000 bonds for an electric light plant.

BELDING, MICH.—The Spencer Electric Light & Power Company is reported as intending to install an electric light plant at Belding.

MAGNOLIA, MISS.—The Magnolia Cotton Mills will install an electric light plant, to illuminate the mills and vicinity. Xavier A. Kramer, of Magnolia, is the engineer.

YAZOO CITY, MISS.—A new water and electric light plant is being installed here. A day power circuit will be put in and an electric railway may be built later on.

MISSOULA, MONT.—It is reported that the Missoula Light & Power Company has in contemplation the enlarging of its plant at Bonner, at a cost of $50,000.

BUTTE, MONT.—The Butte & Anaconda Power Company has been organized to furnish electrical power to the two cities named. It has filed upon 5,000,000 inches of the waters of the Missouri River at Ox Bend. A plant will be constructed at an expense of about $1,500,000. Capitalists of Pittsburg and Chicago are behind the enterprise, which is being pushed here by H. N. Conoll, of Helena, and O. Baur, of Chicago. The transmission line from the plant to Anaconda will be 100 miles in length. Condemnation proceedings have been commenced against the owners of property likely to be damaged by the high water resulting from the construction of the dam.

BRIDGEPORT, N. Y.—Dr. S. Hubbell, of Syracuse, is reported to have purchased a large water-power and milling property at Bridgeport, on Chittenango Creek. He intends to make extensive improvements to the property and will adapt it for the development of electric power, which will be used eventually for an electric railway connecting Syracuse with points along the southern shore of Oneida Lake.

GERMANTOWN, OHIO.—At a recent election it was voted to issue $6,000 bonds for the improvement of the electric light plant.

SUNBURY, PA.—The West Branch Electric Light Company has been incorporated with a capital of $3,000,000, to develop power for the electric lighting of towns from Shamokin to Williamsport. The new company is reported to have procured options on twenty electric light companies and systems.

TIMMONSVILLE, S. C.—This town is contemplating the building of an electric lighting plant.

AMARILLO, TEX.—The Amarillo Water, Light & Power Company will expend about $30,000 for electrical and pumping machinery.

GRANBURY, TEX.—The Granbury Milling Company will install an electric light plant for the purpose of furnishing the town with lights and for commercial use.

TACOMA, WASH.—Porter Bros., of Duluth, Minn., it is stated, have secured a contract from the Columbia Improvement Company, of Boston, Mass., for the development of water power on Puyallup River in Wash., 30 miles from Tacoma. The contract is reported to amount to $350,000.

ARCADIA, WIS.—The Village Council has decided to construct an electric light plant, to cost about $6,000.

EAU CLAIRE, WIS.—It is reported that the Eau Claire Light & Power Company contemplates rebuilding its electric light plant if the lighting contract is renewed. The new plant would cost about $100,000.

ORILLA, ONT.—The Ragged Rapids, on the Severn River, 19 miles from Orilla, were harnessed by the municipality for the production of electric power, at a cost of about $75,000. Some 800 horse power was expected to have been developed, but a defect in the tail race made this amount not available at present. The revenue derived is already $21,237, and the cost of running the works, with repairs, is about $7,500 adding to which the interest on the investment leaves a profit to the town of from $600 to $1,000 on the present power capacity. In addition the town has its street and municipal building lights free. The charge for power is $15 per horse power per annum.

OTTAWA, ONT.—The streets of Ottawa will be lighted by a civic plant next year, if the requisite expenditure is ratified by the ratepayers next January. It is estimated that the cost of installation of the plant, exclusive of poles, as those of existing companies can be used free, will be $40,000, and the annual cost of maintenance about $20,000. The city will buy power from one of the existing companies. The city is now paying $65 per light per annum for street lights. The cost under the operation of the municipal plant will not exceed $42 per light. The lamps will burn 4,000 hours each per year, from dusk to daylight, the moonlight schedule to be abolished. Per hour, the present cost is 2.16 cents; under the civic management it is figured at 1.05 cents.

OTTAWA, ONT.—An effort is being made to resume operations on the works of the Metropolitan Electric Company, at Britannia, six miles from Ottawa, or do something to release the capital which is tied up in the concern. Several years ago the Metropolitan Company secured a civic franchise for the supply of light, heat and power and a large sum of money was spent in the construction of a power canal at the Deschenes Rapids, Britannia, but the company did not proceed further. It is now reported that the company will complete the work or dispose of its interests to some electric power developing concern. A large amount of power is capable of being developed at this point.

THE ELECTRIC RAILWAY.

PLAINVILLE, CONN.—The incorporators of the Plainville & Farmington Tramway Company have organized. The company proposes to operate the road already built. The stockholders are J. T. Patterson, of Bridgeport; J. B. Cornwall, of Bridgeport; Arthur Perkins, of Hartford; Howard H. Knapp, of Bridgeport; W. J. Carroll, of Hartford. They were elected directors of the company, and at the meeting of the directors J. T. Patterson was chosen president and treasurer, and W. J. Carroll, secretary. The directors voted to empower the president to make arrangements for putting the road into operation at an early date. The company is negotiating for cars and for the supplying of power.

PRINCETON, IND.—At the annual meeting of the stockholders of the Evansville & Princeton Traction Company the following directors were chosen: J. S. Heston, S. T. Heston, E. J. Baldwin, W. L. Sonntag, J. G. Legrange. The directors then elected the following officers: President, Joseph S. Heston, Princeton; secretary and general freight and passenger agent E. J. Baldwin, Princeton; treasurer and purchasing agent, Samuel T. Heston, Princeton; general manager, William L. Sonntag, Evansville.

WASHINGTON, IA.—Articles of incorporation of the Iowa City, Kalone & Washington Railway have been filed with the County Recorder of Washington County. The company is organized for the purpose of constructing an interurban electric railway from Iowa City to Washington, a distance of about 24 miles. The capital stock is $50,000, and Washington is named as the principal place of business. The officers are George Rodman, of Washington, president; W. P. Coast, of Iowa City, vice-president; Willard J. Welch, of Iowa City, secretary; G. M. Kacvk, of Washington, treasurer.

LOUISVILLE, KY.—The Kentucky Traction Company has filed amended articles of incorporation. The capital stock is increased to $5,000,000 and the bonded indebtedness to the same amount. The company is given the right to build a line from Rock Haven to Owensboro and one from Hopkinsville to Bowling Green.

NEW ORLEANS, LA.—A large contract has been closed by Knox, George & Company, for the construction of an interurban railway line at Birmingham which will cost when completed about $800,000. The new company, which will be known as the Birmingham & Steel Cities Railway & Power Company, will construct 40 miles of road, which, while operated in the same general district as that covered by the older company, will open up entirely new territory. In addition to being the largest contract of the kind ever let to a New Orleans firm, the line, when completed, will be the longest interurban line in the South.

SPRINGFIELD, MASS.—The Springfield Street Railway Company has received petitions from the towns of Hampden, Mass., and Stafford Springs, Conn., for an extension of its lines to those places. The petitions have the support of the Springfield Board of Trade.

DETROIT, MICH.—The Hawks-Angus syndicate has sold the Lansing Street Railway to Nelson Mills, of St. Marys, and his associates. The consideration is said to have been $200,000. They will merge it with the Lansing, St. Johns & St. Louis Railway. The sale agreement gives the Hawks-Angus syndicate entry over the Lansing system for the Lansing-Battle Creek line.

SAVANNAH, MO.—The St. Joseph, Savannah & Northern Street Railway Company of Savannah has been incorporated. It is proposed to construct an interurban line between the above-named cities.

JOPLIN, MO.—An Eastern syndicate, headed by Major William Vincent, of the United States Guarantee Loan & Trust Company, of New York City, proposes to build an electric railway between Joplin and Kansas City. The road will be 170 miles long. It is the intention of the company to do a general freight as well as passenger business.

MANCHESTER, N. H.—All the directors of the Manchester Traction Light & Power Company and the Manchester Street Railway Company were re-elected at meetings of these corporations held at the Manchester office Sept. 16. They are as follows: Traction, Light & Power Company—William A. Tucker, of Boston; George H. Hood, of Boston; Walter M. Parker, Gerge B. Chandler, R. G. Sullivan, Harry E. Parker, J. Brodie Smith, of this city; S. Reed Anthony, of Boston; Stillman F. Kelley, of Boston; Billings P. Learned, of Boston; R. H. Hallowell, of Boston, and Charles M. Floyd, of Manchester. Manchester Street Railway Company—Philip L. Saltonstall, of Boston; Walter M. Parker, of Manchester; S. Reed Anthony, of Boston, and David A. Taggart, of Manchester.

NEWARK, N. J.—A part of the trolley system of the Public Service Corporation was tied up last Thursday evening by a strike of employees. A few of the lines to outlying towns were affected for a few hours. The strike seems to have been premature. The company refused to negotiate with representatives of associations, but expressed its willingness to treat with individuals or committees of employees.

JERSEY CITY, N. J.—Service out of the United States Circuit Court secured last week on the officers of the Union Railway, Power and Electric Company in Jersey City and upon co-defendants Frederick K. Day, receiver of the American Union Electric Company; George Riker, James S. Riker, William F. Bailey, Charles W. Alling, Harry W. Hungerford, Calvin G. Hungerford and Charles A. Hungerford, in the suit for foreclosure on the property of the Union Railway, Power & Electric Company brought by the McVicar Realty Trust Company, of New York. The bill of complaint notes the fact that the Union Railway & Power Company was adjudged insolvent by the Chancery Court of New Jersey, and a receiver in the person of Frederick K. Day appointed Oct. 29, 1902.

NYACK, N. Y.—The Rockland Railroad Company was granted a franchise in South Nyack on Sept. 10.

NEW YORK, N. Y.—Mayor Low has affixed his signature to the franchise granting to the Union Railway Company the right to cross Macomb's Dam Bridge and Viaduct, thus giving residents of the Bronx an outlet from their borough directly into Manhattan.

UTICA, N. Y.—At the annual meeting of the stockholders of the Utica & Mohawk Valley Railway Company the following directors were re-elected for another year: Horace E. Andrews, John J. Stanley, Alden M. Young, Nicholas E. Devereux, Charles B. Rogers, Walter N. Kernan, David H. Burrill, William E. Lewis and James S. Sherman.

NEW ROCHELLE, N. Y.—The power house of the Union Street Railway Company at Washington and Webster Avenues was completely destroyed by fire on the morning of September 19. All the trolley lines of New Rochelle and those running to Mount Vernon, Larchmont, Tuckahoe and Glen Island are supplied by the plant. It will take months to rebuild the plant, which cost over $100,000.

DELAWARE, OHIO.—The Delaware & Magnetic Springs Railway Company has commenced the erection of a power house on the Scioto River, near here. The plant will be completed shortly after the first of the year.

CLEVELAND, OHIO.—A franchise has been granted by the City Council to a proposed street railway company, which is to charge a three-cent fare. It is the first franchise of its kind in the city. Mayor Johnson is said to be interested in the new line.

CLEVELAND, OHIO.—The Eastern Ohio Traction Company is planning extensive improvements on its Garrettsville division. It is probable that the power equipment will be improved and that new rolling stock will be added. George L. Bishop, the newly elected president, is formulating the plans.

AKRON, OHIO.—The Northern Ohio Traction & Light Company has placed contracts for the installation of a 2,500-hp engine and generator to be delivered about Jan. 1. The company has placed a contract for ten new cars. It is the intention to install limited service on the line between Cleveland and Akron.

CLEVELAND, OHIO.—The Westinghouse Electric & Manufacturing Company has commenced the erection of the Elyria power station of the Cleveland & Southwestern Traction Company of the two 1000-kw alternating-current Parsons turbine sets ordered some time ago. Three 500-hp Heine boilers are to be installed. A new switchboard and transformers are also to be installed.

CLEVELAND, OHIO.—A meeting of the stockholders of the Muncie, Hartford & Fort Wayne Traction Company has been called for Sept. 25 for the purpose of financing the company. It is announced that an outside banking house has agreed to take the entire issue of bonds providing some of the issue is retired. The bonds are now held to secure a loan over and above that paid on the original underwriting for the construction of the road.

CINCINNATI, OHIO.—Construction has been started on the west end of the Indianapolis & Cincinnati Railway between Rushville and Indianapolis. The survey from Rushville to Connersville is completed, and the line from Hamilton through Oxford to Connersville is well under way. The line will be built for high speed, and it will aim to compete with the steam roads for through traffic. Charles L. Henry is president and general manager of the company.

WASHINGTON C. H., OHIO.—The Ohio River & Columbus Railway Company has filed a mortgage for $1,000,000 in favor of the Union Savings Bank & Trust Company, of Cincinnati. The mortgage secures bonds for the construction of a steam and electric road through Franklin, Madison, Fayette, Pickaway, Highland and Brown counties, Ohio. The line will extend from Maysville, Ky., to Washington C. H., where connection will be made for Columbus. The road will be constructed for handling freight trains by steam. The officers of the company are G. Baumbach, president; E. E. Galbreath, vice-president; W. G. Wagenthals, general manager. W. G. Wagenthals & Company, of Cincinnati, are the contractors for the road.

PETERBORO, ONT.—An agreement has been entered into between the corporation of Peterboro and the Peterboro Radial Railway Company, by which the latter is given a franchise to operate a street railway in the city, to extend over a period of 30 years from July 1, 1904. The company will use the tracks of the defunct Peterboro & Ashburton Railway Company, and agrees to have the system in operation not later than July next. The capitalists interested in this enterprise are those identified with the American Cereal Company, including Senator Cox, of Toronto. The company will spend $250,000 on a new dam and power house.

ALLENTOWN, PA.—The Lehigh Valley Traction Company has begun running cars through from this city to Bangor.

PALMYRA, PA.—Surveys have been made for a four-mile electric railway between this place and Valley Glen Park, in which Philadelphia capitalists are interested.

JOHNSTOWN, PA.—Surveys have been completed for the new Johnstown, Woodvale Heights & East Conemaugh Street Railway, which was chartered Aug. 31. The new line will be about four miles long.

CHAMBERSBURG, PA.—The Town Council has granted the Chambersburg & Gettysburg Electric Railway Company a franchise to build a line on East Queen Street between Main and Second Streets, thus reducing the running time between this town and Fayetteville when the line is completed.

DANVILLE, PA.—The Danville & Bloomsburg Street Railway Company, capital $36,000, was chartered Sept. 21 to build a six-mile electric railway from Danville to Bloomsburg. William F. Pascoe, of Allentown, is president of the company.

JOHNSTOWN, PA.—The Johnstown, Woodvale Heights & Conemaugh Street Railway Company was chartered Sept. 21, with a capital stock of $30,000, to build a five-mile electric railway from this city to East Conemaugh. Joseph H. Berlin, of Johnstown, is president.

HARRISBURG, PA.—The Blenside & Willow Grove Street Railway Company, capital $24,000, was chartered here Sept. 21, to build a four-mile electric railway from Keswick Avenue, Philadelphia, to Willow Grove Park. C. P. Weaver, of Philadelphia, is president of the company.

BEAVER, PA.—A charter was granted at Harrisburg, Sept 21, to the Northern Street Railway Company to build a five-mile electric railway from College Hill to Big Beaver via Homewood and Hoytdale. William Redwood Wright, of Philadelphia, is president of the company, and the capital stock is $30,000.

MORRISVILLE, PA.—A charter was granted at Harrisburg Sept. 21 to the Delaware River & Morrisville Street Railway Company, capital $60,000, to build ten miles of line from this place and across the Delaware River Bridge here to the dividing line between Pennsylvania and New Jersey, near Trenton. Samuel Rea, of Bryn Mawr, is president of the company.

MONTREAL, QUE.—The Montreal Street Railway Company has decided to increase its capital stock to $7,000,000, an increase of $1,000,000. The increase is to carry out a plan of extension of the lines and also to provide additional rolling stock.

CHATTANOOGA, TENN.—At a meeting of the stockholders of the Chattanooga Electric Railway Company to be held in the latter part of September, or early in October, decision will be reached on the contruction of an electric railway up Lookout Mountain and a line to Chickamauga Park.

CLARKSVILLE, TEX.—It is announced that the promoters of the proposed interurban electric railway between this place and Mt. Pleasant, Tex., by way of Rosalie and Bogata, have perfected the necessary financial arrangements for the early construction of the road.

FORT WORTH, TEX.—F. M. Haines, general manager of the Northern Texas Traction Company, of this city, says that the company's interurban electric road across the bottoms between Fort Worth and Dallas will be double-tracked within the next fourteen months.

HAMPTON ROADS, VA.—Application has been filed for a receiver for the Hampton Roads Railway & Electric Company by Jno. G. Powell and Brothers, of Philadelphia, they being the principal stockholders. It is alleged that the company is insolvent.

NEW INDUSTRIAL COMPANIES.

THE STERLING MOTOR COMPANY, of Binghamton, N. Y., has been incorporated with a capital of $25,000. Directors: O. S. Heller, F. H. Matthews, and H. W. Edson, Binghamton.

THE ADDISON GAS AND POWER COMPANY has been incorporated at Addison, N. Y.; capital, $50,000. Directors: M. T. Cassada, Webbs Mills; J. B. Rumsey, Oswayo, Pa.; L. B. Seibert, Coudersport, Pa.

LEGAL.

LIGHTNING OVER TELEPHONE WIRE.—In the appeal case of the Southern Bell Telephone & Telegraph Company vs. M. C. Tyer, the Supreme Court of Alabama has affirmed the decision of the lower court in favor of the plaintiff, M. C. Tyer, whose place has been struck by lightning that came in over the telephone wires. It was held that where a telephone company, having previously maintained a telephone in a store, on being requested to remove the same removed the instrument, but against the proprietor's protest neglected to remove the wires, merely twisting the ends of the wires together inside the building, and by reason thereof atmospheric electricity was conducted into the store and injured plaintiff, who was lawfully in the store on business with the proprietor, defendant's failure to remove the wires from the building was negligence per se, entitling plaintiff to recover for the injuries sustained.

TELEPHONE POLE ACCIDENT.—At Cambridge, Mass., a market wagon wheel ran into a depression in the street, the wagon lurched and came in contact with a slightly leaning pole of the New England Telegraph & Telephone Company. A rider in the vehicle was hurt by the pole, and a verdict in his favor against the company has just been sustained by the Supreme Judicial Court of Massachusetts. One of the judges dissented, however, remarking: "It will be curious to see how far the majority of the court will carry its interpretation of the statute. It frequently happens at the present time that an automobile gets beyond the control of the person in charge, and plunges into a telegraph pole outside the traveled part of the way, and the automobile or the person in charge is injured. Is the owner of the pole to be held liable? Again, an open trolley car leaves the track owing to a defective rail, and a passenger is thrown against a telegraph pole. Is the owner thereof liable? I cannot think that the Legislature intended any such consequence to result from the language used in the statute. Statutes are to be construed reasonably, and it seems to me that the construction put by the majority of the court tends to most unreasonable results."

MAY EAT PEANUTS.—The jury at New Brunswick, N. J., which heard the evidence in the suit of Alvie Peterson against the Middlesex & Somerset Traction Company gave Mr. Peterson a verdict of $400. Peterson had been eating peanuts in a car and declined to stop when ordered by the conductor to do so. The conductor, James Crossen, thereupon threw him off the car and injured him. Mr. Peterson instituted criminal proceedings against Crossen and the man was indicted, but at his trial he was acquitted. Then Peterson sued the company. Supreme Court Justice Fort, in his charge to the jury, plainly laid down the principles of the law in such cases. He said that a carrying company enters into a contract with its passengers to use a high grade of cars in carrying them, and that if an unlawful assault is made the carrier is liable for the act of its employee while the employee is acting in the capacity of employee. The company may establish reasonable rules that they may enforce on their cars, he said, but the passengers are not bound by those rules unless the rules are posted in the car or the passengers are notified of them. In the enforcement of the rules the company is not permitted to use any more force than necessary. Crossen was enforcing a rule that peanut shells are not permitted on the floor of trolley cars.

PERSONAL.

MR. D. W. COONS, manager of the Hydra Battery Company, New York, is around again after a severe and painful illness.

MR. RUDOLPH BUECKING, manager for Hugo Reisinger, New York, has gone to Europe for a short trip, combining pleasure with business.

MR. E. THURNAUER, of the French Thomson Houston Company, is again visiting this country and may be here some little time before returning to Paris.

MR. RUDOLPH MIEHLING has taken charge of the New York office of the Walker Electric Company, of Philadelphia, having come from the factory in that city.

MR. ISAAC M. HUTCHISON, of Mexico City, who represents prominent American manufacturing concerns in Mexico, is now in New York City at the Hotel Manhattan.

MR. A. E. WARSWICK, formerly chief engineer of the electric traction system of Mexico City, controlled by the London financial house of Wernher Beit & Company, has sailed for Europe.

MR. FRED. W. EWALD, former manager of the Consolidated Schools Company, and Mr. Leonard W. Seelisberg, former vice-president and secretary, have severed their connection with the company and will take up work of a different kind.

MR. RALPH D. MERSHON sailed on Sept. 25 for Europe,. He will return about the middle of November. His visit abroad is in connection with engineering work on which he has been retained by a prominent company in this country.

MR. PAUL J. KRUESI, manager of the Sunlight Lava Mfg. Company, of Chattanooga, Tenn., has been spending a couple of weeks north, visiting friends and transacting business. The concern is very busy on electrical and acetylene supplies.

MR. CHARLES S. DRUMMOND, who recently resigned the financial directorship of the British Electric Traction Company for the purpose of assuming the presidency of the Manhattan Transit Company has vacated that position. He sailed for Europe Saturday last.

MR. DE VERE STEVENS has left for South Africa in the interests of the recently reorganized Export Club of America, 9 South William Street, of which several electrical men concerned in foreign trade are members. Mr. Stevens expects to be absent about six months.

MR. J. H. VAIL, so well known in Edison circles, and for some time chief engineer of the system in Philadelphia, is now associated with the Pennsylvania Iron Works, and busily engaged on several important engineering matters for them. He was a visitor in New York last week.

MR. A. FREDERICK COLLINS has already booked for this season some twenty engagements to lecture, with demonstrations, on wireless telegraphy and telephony. His first lecture takes place this week, October 2, before the Business Men's Association of Poughkeepsie, N. Y.

MR. M. R. McADOO, formerly connected with the Pittsburg McKeesport & Connellsville electric traction system and now president of the Compania Mexicana de Traccion (Mexican Traction Company), Mexico City, has just left New York for Mexico City to start construction work.

MR. CHARLES F. JOHNSON, who has made a great success in Buffalo in dealing in new and second-hand electrical and kindred machinery, has decided on a new step which will give him broader scope. He is opening a New York office which in all probability will be headquarters, and from which it is likely his Buffalo business will be conducted.

MR. C. J. GLIDDEN.—A cable dispatch from London announces that Mr. and Mrs. Charles J. Glidden, of Lowell, Mass., have returned to London after completing an automobile Arctic tour of 6,670 miles. Mr. and Mrs. Glidden sailed from Boston in June for England, whence they began their tour through Europe, in the course of which they crossed the arctic circle.

MR. R. T. LAFFIN.—Richard T. Laffin, general manager of the great system of the Worcester Consolidated Street Railway Company, has sent in his resignation, to take effect Jan. 1. He is to go to the Philippines to be general manager of the Manila Electric Railway Light & Power Company. Mr. Laffin went to Worcester to his present position on Jan. 1, 1901.

MR. THOMAS C. WOOD, president of the Ball & Wood Company, the well-known high speed engine builders, has just returned to New York, from Europe. He visited England and the Continent, making casual observation of technical affairs; but the bulk of the time—some two months—was spent with a friend in a delightful walking tour through Switzerland. Mr. Wood finds himself greatly benefitted by this quiet and leisurely experience.

CHILDS—COFFIN.—Miss Jenny Coffin, daughter of Mr. C. A. Coffin, president of the General Electric Company, was married at Lynn, Mass., on Sept. 23, to Mr. Sterling W. Childs, of Pittsburg. Guests were present from England, Germany and many cities in this country. The ceremony was performed by Rev. G. A. Gordon, pastor of the Old South Church, Boston, who is an intimate friend of the bride's parents. It is stated that the wedding presents are valued at $250,000.

MR. EUGENE L. ASHLEY, president of the Hudson River Water Power Company was the guest of honor at a testimonial banquet tendered to him at the United States Hotel, Saratoga, N. Y., on Sept. 24. The affair was gotten up by the leading citizens of Glens Falls, South Glens Falls, Sandy Hill, Fort Edwards and other towns as a testimonial to Mr. Ashley's pluck and perseverance in carrying forward the construction of the big power works at Spier's Falls on the Hudson River.

MR. W. J. KELLY, of Guatemala City, Guatemala, one of the firm of Van de Putte & Company of that city, dealers and jobbers in machinery, is in New York getting information and estimates for electrical machinery and material for the Guatemala market. He is especially looking up small commercial plants, incandescent lamps and fans. Electrical machinery is practically admitted duty free in Guatemala, and that country offers for American made goods a fine market which heretofore has been monopolized by the Germans, French and English. Mr. Kelly is a large dealer also in farm and plantation machinery.

EDUCATIONAL.

TRAINING FOR FOREMEN.—With the object of training artisans for the position of foremen it has been decided to substitute for the advanced courses which have hitherto been given by the Lowell Institute, Boston, an evening "School for Industrial Foremen," to comprise at the outset two courses, one mechanical and the other electrical, both extending over two years. The subjects in the first year for both courses will be practical mathematics, elementary physics and electricity, elements of mechanism and gearing, and drawing. The subjects taught in the second year of the mechanical course will be mechanics, valve gears, elements of thermodynamics, the steam engine and boilers, elementary hydraulics, testing laboratory, steam and hydraulic laboratory and mechanism, and elementary machine design. The second year of the electrical course will include valve gears, elements of thermodynamics, the steam engine and boilers, steam laboratory, direct-current machinery, alternating currents, electric distribution, electrical testing and dynamo laboratory. The first session will open in October and continue through April. The instruction will be given by means of recitations, lectures, drawing room practice and laboratory exercises, and it will be given at the Institute of Technology by members of the instructing staff of that institution. To be admitted applicants must have a good knowledge of arithmetic, including the metric system, elementary algebra, plane geometry and mechanical drawing. Like all courses conducted by the Lowell Institute, the instruction is free.

FRANKLIN INSTITUTE LECTURES.—The course of lectures announced by the Franklin Institute, Philadelphia, for 1903-4 includes Mr. W. J. Hammer on radium; Prof. R. W. Wood on fluorescence, etc.; Dr. Lee De Forest on wireless telegraphy; Wm. Martin I. Wilbert on Roentgen ray therapeutics; Mr. A. A. Knudson on underground electrolysis; Dr. M. G. Lloyd on the theory of electrons; Pr. J. W. Richards on the electrolysis of water; Dr. E. F. Roeber on the electrometallurgy of iron and steel; Mr. C. J. Reed on Faraday's electrochemical work; Mr. Clarence J. Messer on telpherage; Mr. W. E. Harrington on rail bonds; Mr. W. M. Scott on circuit breakers; Mr. Mortimer Norden on electric carriage calls and electric signs; Dr. W. E. Winship on storage batteries in street railway operation.

BROOKLYN INSTITUTE.—The Brooklyn, N. Y., Institute of Arts and Sciences, has issued an excellent prospectus for 1903-1904, in which the various electrical and allied departments are well represented. In chemistry a course of six lectures is to be delivered by Prof. Harry C. Jones, of Johns Hopkins University, in which electrolytic dissociation, etc., will come up. Prof. John S. McKay, of the Packer Institute, is to deliver a course of eight illustrated lectures on "Recent Discoveries in Physical Science and their Relation to Theories of Matter and Energy." In the Department of Electricity also Prof. E. R. von Nardroff will deliver a course of six illustrated lectures on "The Electron Theory: Its Experimental Basis and its Chemical and Physical Applications." In mineralogy, Mr. W. Goold Levison is to lecture on the "Magnetic and Electric Properties of Minerals."

OBITUARY.

MR. W. H. HILL.—We regret to note the suicide of Mr. W. H. Hill, of the foreign department of the General Electric Company, at Orange, N. J. He had returned recently from Mexico after a long stay abroad, and was in very poor health. He complained of his inability to sleep, and appears to have brooded over his own condition, as well as that of his father, who has also been ill. Mr. Hill was quite a young man and was formerly at the Schenectady works.

MR. HENRY STEERS.—A sad accident occurred at Westport, R. I., on September 29, when Mr. Henry Steers, while fishing in the harbor, was drowned from his boat. He was a well-known banker, and son of the designer of the famous schooner yacht *America*, which won the Cup. He was early interested in electrical matters, giving active support to his friend, Mr. E. H. Johnson, the pioneer in so many useful new enterprises. He was a director of the Dry Dock, East Broadway & Battery Railway Company, of the Dubuque and Sioux City Railroad Company, of the Interior Conduit & Insulation Company, the New York and Boston Dyewood Company, the Rubber Goods Manufacturing Company, and the State Trust Company. He was, besides, a member of many clubs, including the New York Yacht Club, the Union, the Racquet and Tennis, and the Engineers' Club. He left a widow and a son, Henry Steers, Jr., a contracting engineer.

Trade Notes.

EXHAUST HEADS FOR LONDON.—Sixteen Burt exhaust heads were recently sent to London, England, by the Burt Mfg. Co., Akron, Ohio.

THE HEALD MACHINE COMPANY has succeeded to the business lately carried on as manufacturers of machinery and tools, at Barre, Mass., under the style or firm name of L. S. Heald & Son.

THE PITTSBURG BRANCH of the H. W. Johns-Manville Company, on account of increased business, has secured larger quarters by taking the adjoining property, and now occupies the entire building at 218-220 First Ave.

STANLEY INSTRUMENT COMPANY, of Great Barrington, Mass., has issued a four-page bulletin with regard to its Stanley recording wattmeter for alternating current circuits. The brochure is a closely printed and closely reasoned technical discussion of the principles and features of the instrument.

THE PITTSBURG TRANSFORMER COMPANY, Pittsburg, Pa., is continuing the mailing of monthly calendars. In the October publication appears a girl dressed in Colonial style, while the business part of the calendar is contained in the terse statement that more Pittsburg transformers were sold in September, 1903, than ever before.

THE EASTERN ARM & PIN COMPANY, of New Bern, N. C., is now equipping another plant to especially manufacture large, special arms for street railway and power line work. Its business in this line both for domestic and foreign consumption has grown to such large proportions that it has been obliged to separate it from its general cross arm business.

TELEPHONE EQUIPMENT.—The International Telephone Manufacturing Company, Chicago, reports having constantly increasing demand for its improved generator-call telephones and its new manual and self-restoring drop switchboard equipment. Among its recent equipments was an order for a complete public exchange outfit for E. A. Schuman, of Jacksonville, Fla.

EXCELSIOR BATTERY AT A LOW PRICE.—The Excelsior Dry Battery Manufacturing Company, 32 Vesey Street, New York, is offering to send to responsible telephone companies, on six months' approval, a 5x2 cell which it states is far more efficient than the ordinary cell. It is offering it at a very low price, and will be glad to hear from telephone companies in regard to the matter.

MR. E. L. VOGEL, formerly with the Chas. Munson Belting Company, has accepted a position with the Grafton & Knight Mfg. Company, 54 Canal St., Chicago, as special agent. The Grafton & Knight Company are well known as manufacturers of belting of the highest quality, and are to be congratulated upon having secured the services of one so well and favorably known to the belting trade as Mr. Vogel.

THE VIRGINIA LOCUST PIN COMPANY, with headquarters at New Bern, N. C., is now operating large plants in three states, Virginia, North Carolina and Tennessee. The product of its factories in northern Virginia is used for making prompt deliveries north and east, that in Tennessee for prompt deliveries west, and that in North Carolina for southern distribution. It has great advantages in the way of freights.

THE BARRIETT ELECTRIC COMPANY, Cincinnati, Ohio, has opened its own salesroom and wareroom in the Havemeyer Building, New York. Its representative, Mr. C. J. Purdy, will carry in stock a full line of motors from ½ to 10-hp, all voltages. Mr. Barriett has had a great deal of success with these machines and the stock which is to be placed in New York will give him opportunities for broadening his work and market.

THE HOBART ELECTRIC MFG. COMPANY, Troy, Ohio, has recently enlarged its factory and increased its manufacturing facilities to such an extent that it can make immediate deliveries of dynamos. As a matter of fact, on regular sizes it is willing to take telegraphic orders where it is essential that machines be secured promptly. The company is a well-known manufacturer of dynamo electric machinery and has been successful in building up an excellent business in the middle west.

ELECTRICAL SUPPLY THEFT.—The Manhattan Electrical Supply Company, New York City, had its suspicions aroused as to some of its employees, and arrests of three were made this week, two being truckmen and one an elevator man. It is stated that these persons had been stealing supplies together for some months past, with the collusion of a receiver of the stolen goods. The supplies are estimated to be worth more than $20,000, and were taken away in cases. They consisted chiefly of keys, sockets, etc.

INCANDESCENT LAMP METER.—The Talmont Electric Engineering Company, 150 Nassau Street, New York, is marketing an ingenious device for the measurement, at an incandescent lamp, of the amount of current consumed by the lamp. It consists of an ammeter built in the receptacle between the plug and socket. The ammeter is designed for direct and alternating currents, and is compact in size. The company also builds high-class instruments to specifications. It reports meeting with much success with its products.

THE EUREKA ELECTRIC COMPANY, formerly of Chicago, has bettered itself extensively by removing its plant to Genoa. It not only is in position to manufacture more cheaply, but its additional capacity has aided it to make more prompt shipments. Within the last week it has closed ten distinct contracts on telephone switchboards, not smaller than 400 capacity each, and up to very large central energy equipments. Among new printed matter may be found its high art No. 23 catalogue, as well as Bulletins No. 26 and No. 27 relating to its later switchboard products.

ORDER FOR ROOFING.—The largest orders ever given for roofing recently placed by the War Department with the H. W. Johns-Manville Company, 100 William Street, New York, for roofing to be used on the Army Buildings in the Philippine Islands. A total of 14,020 rolls of two squares, over 900 tons, was ordered; enough to cover 65 acres, or make a strip a yard wide 200 miles long. Ten bids were submitted and the award was made only after careful investigation by the War Department and the supervising architect of the Treasury. Prompt delivery was essential and it is of interest to note that one order for 11,120 rolls was completed within 30 days, and another for 2,900 rolls within ten days of receipt.

GLOBE ELECTRIC MFG. COMPANY, of Gordon Avenue, Cleveland, Ohio, has recently introduced a novel form of combination arc and incandescent headlight for electric cars. It has two circuits. On one is an enclosed arc, with mechanism for elevating the lamp out of focus with the reflector, for the purpose of dimming the light when entering city limits. A small rheostat goes with the lamp which is adjustable for 2 to 5 amp. on a drop of 300 volts. It burns ⅜ in. carbons. On the other circuit are four incandescent lamps to be thrown in when the arc is cut out, according to whether the car is within or outside city limits. The change of light is made by inserting either the arc or incandescent positive plug into the receptacle or by operating a two point switch in the vestibule of the car.

DECORATIVE LAMPS.—While incandescent lamps lend themselves very readily to decorative effects, the beauty of brilliancy and decorative illumination is frequently enhanced by the inclusion of a color scheme. It is not always worth while to buy lamps made with frosted or colored bulbs especially if the decoration is only temporary. Therefore the next best thing is to get a coloring preparation which will give all the result of a permanently colored lamp or of a frosting solution which will give similar results. Several manufacturers have placed such compounds on the market. Of one of these, Mr. Francis Granger, 26 Cortlandt St., New York, has been appointed Eastern sales manager and is now prepared to offer it in connection with the Sterling Special lamps which have become justly famous in part through Mr. Granger's aggressiveness.

PERKINS SWITCHES.—The Perkins Electric Switch Mfg. Company, of Bridgeport, Conn., has just issued a new catalogue 6½x3¾ inches, convenient pocket size, comprising 192 pages, in dark green buckram cover with rounded corners. On the front cover is shown a nickel-plated flushplate, with two rotary flush switches. On the back cover is shown the Perkins key socket with shade holder rigidly attached to the shell. The latter is one of the new goods, shown for the first time in this catalogue. No fewer than 1,200 articles are enumerated in the catalogue, each with an individual catalogue number and telegraph code word. The cuts are in half-tone, bringing out remarkably well the qualities of the goods made in porcelain. The Perkins Company will be glad to have requests for the catalogue sent to any electrical supply house in the country. The catalogue is not distributed direct to the consumer.

STANDARD VITRIFIED CONDUIT.—President B. S. Barnard, president of the Standard Vitrified Conduit Co., 39 Cortlandt St., New York City, has just issued to the trade a circular as follows: "We have on hand a large stock

of multiple and single type conduits in all sizes. Can make immediate shipment. Our factories are in full operation, producing over 80,000 duct-feet of conduit per day. We solicit your orders, and if any of your conduit operations are being delayed by non-delivery of conduit, communicate with us, stating style and number of duct-feet required, and we will at once quote low price delivered on cars at factory or at destination. There may be rumors in the trade that we are not operating our works. If you place order with us we will prove by prompt shipment that rumors are without foundation. The excellent quality of our material is well known. Many of the largest contracts awarded during the past year have been satisfactorily supplied by us."

STOW MULTI-SPEED MOTORS.—The Stow Manufacturing Company, Binghamton, N. Y., has recently issued a neat and well-illustrated bulletin of 32 pages on the subject of its multi-speed motors. This bulletin describes these motors quite clearly, both in construction and operation and shows various applications to machine tools. This method of speed variation admits of a range of speed in the ratio of 1 to 2½. It is claimed that the motor is capable of developing its full rated load at any speed within its range with practically uniform efficiency, and for this reason is well adapted for a large variety of uses. The absence of any auxiliary controlling resistances and the fact that the motor requires but one voltage only, makes the machine especially desirable in many installations where compactness, ruggedness and simplicity are required. The company will be pleased to mail copies of this Bulletin (No. 52) to any interested parties.

MOTOR BOOK.—The Robbins & Myers Company, Springfield, Ohio, in its bulletin No. 32, recently issued, illustrates and describes its complete line of power motors and dynamos. A number of improvements in these machines have been introduced during the past two years, and several sizes have been added to the list. As regards the different sizes there are 14 frames in all, 15-hp being the largest and 1-30-hp the smallest, with sufficient intermediate capacities for almost all purposes. A belt adjusting base is regularly furnished with each machine of ¼-hp and upward, and the convenience of side wall or ceiling suspension are points that appeal favorably to most conditions. Particularly valuable features of the publication are the chapters entitled "Notes on Selection of Motors," and "Installation and Care of Motors." The bulletin is well illustrated with views of type-representative machines, of details, dimensions, diagrams, etc. The usual tables, code words, etc., are included.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPTEMBER 22, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

739,282. JOINT COVER OR KICK PLATE; Christian C. Bohn, New York, N. Y. App. filed Feb. 21, 1903. A strap plate intended to cover the joint between a wiring molding and a wall conduit.

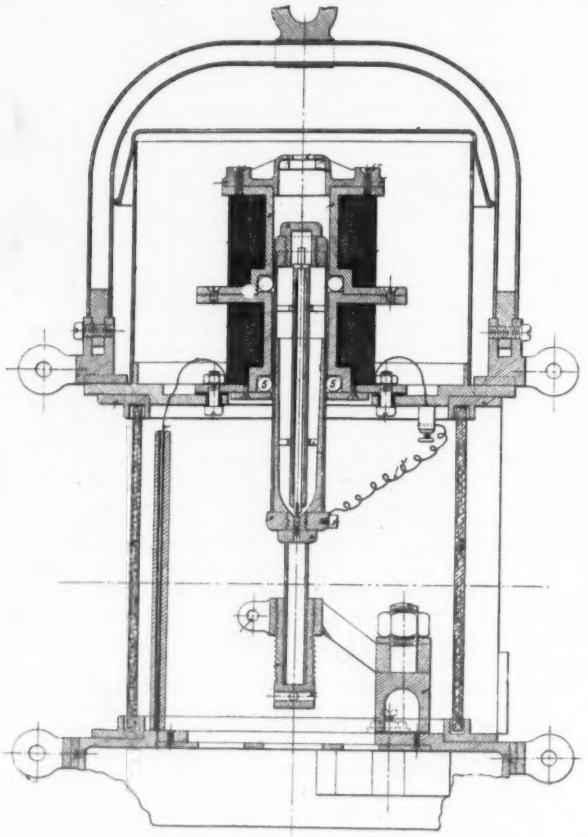
739,287. WIRELESS TELEGRAPHY; Elmer E. Butcher, North Ridgeville, Ohio. App. filed April 11, 1903. A device which automatically connects the transmitter and disconnects the receiver with the aerial conductor each time the key is depressed and vice versa each time the key lifts, thereby maintaining the receiver in circuit at all times except the instants when the transmitter is operating.

739,359. ELECTRIC LIGHT SIGNAL; Valdemar Taboulevitsch, Sselo Alexandrowskoje, St. Petersburg, Russia. App. filed May 14, 1902. Means for inserting powdered material between the pencils of an arc light to change the color of the light emitted.

739,396. ELECTRIC ATTACHMENT FOR PIANOS; George H. Davis, Orange, N. J. App. filed May 9, 1901. Among other improvements the invention includes means for changing the flow of current through the key-operating magnet helices from multiple to series to increase the resistance and avoid sparking at the contacts.

739,432. TERMINAL FOR STORAGE BATTERIES; Jacob Wilfrid Madigin, Toronto, Canada. App. filed Jan. 10, 1903. (See page 551.)

739,433. ELECTRICAL CONTROLLER; Gustave C. Marx, Elizabeth, N. J. App. filed July 2, 1903. The handle and resistance controlling lever of a rheostat are pivoted in a tight cover which protects the contacts from dust, etc.



739,359.—Electric Light Signal.

739,448. ART OF MAKING BLEACHING COMPOUND; Marcus Ruthenburg, Harrisburg, Pa. App. filed Jan. 14, 1902. (See page 551.)

739,464. RAILWAY RAIL JOINT; George A. Weber, Stamford, Conn. App. filed June 2, 1902. A pocket is formed in a plate set beneath the joint, for a bond.

739,469. INSULATED TWIN JOINT; George A. Weber, New York, N. Y. App. filed May 28, 1903. Details.

739,518. RAILWAY BLOCK SIGNALING SYSTEM; Herbert B. Taylor, Newark, N. J. App. filed Aug. 2, 1901. Details of a track circuit system.

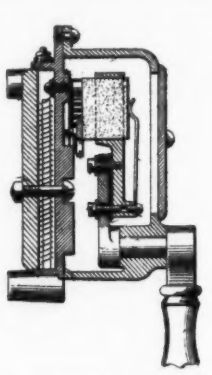
739,569. APPARATUS FOR LOCATING SHORT CIRCUITS IN ELECTRIC LINES; William W. Woodruff, Winchester, Ky. App. filed March 19, 1903. A magnetic needle is pivoted so that its opposite ends or poles stand between the abutting ends of two semi-circular electro-magnets which are respectively in circuit with the line to be measured and a branch line. The needle maintains this position as long as the two lines balance.

739,572. SYSTEM OF MOTOR CONTROL; Albert H. Armstrong, Schenectady, N. Y. App. filed June 15, 1900. A feature of this invention is the construction of the master controller in such a manner that current may be supplied from an alternating current source to the controlling circuits without at any time opening a circuit through which current is flowing.

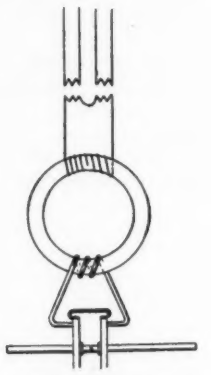
739,577. MOTOR CONTROL SYSTEM; Charles E. Barry and William O. Mundy, Schenectady, N. Y. App. filed May 8, 1902. A controller having one lever with a motion in one direction during which the control of a small motor is first effected and afterwards the proper starting and control of a larger motor is accomplished, such an arrangement of motors being commonly used on large printing presses for threading in the paper and afterwards for the regular drive.

739,588. ELECTRIC BRAKING; Frank E. Case, Schenectady, N. Y. App. filed July 6, 1900. The magnetization of the brake actuating devices can be reduced as the speed of the vehicle decreases without reducing by a corresponding amount the current generated by the motors under momentum.

739,598. END PLAY DEVICE; Henry Geisenhoner, Schenectady, N. Y. App. filed May 8, 1903. A spring pin abuts against the end of an armature shaft and causes end-play thereof.



739,433.—Electrical Controller.



739,601.—Metal Working by Electricity.

739,599. SEARCH LIGHT PROJECTOR; John L. Hall, Schenectady, N. Y. App. filed Feb. 24, 1903. The motors for moving the projector are controlled by switches in the base of the projector which in turn are operated by a master controller from any distant point.

739,601. METAL WORKING BY ELECTRICITY; Daniel E. Johnson, Hartford, Conn. App. filed March 14, 1903. An arrangement of transformers whereby the commercial polyphase systems can be utilized for metal-working purposes.

739,632. TROLLEY CATCHER AND REPLACER; James V. Ainsworth, Los Angeles, Cal. App. filed June 22, 1903. Details.

739,636. SWITCHBOARD FOR TELEPHONES; George F. Archer, New York, N. Y. App. filed Feb. 4, 1903. (See page 565.)

739,671. SUPPORT FOR ELECTRIC FIXTURES; Charles A. Hannan, New York, N. Y. App. filed May 6, 1902. A hanger consisting of a short coupling threaded at each end to fit the end of the conduit and the fixture and provided with a passage which leads laterally outward for the electrical conductors.

739,672. ELECTRIC SWITCH; John Harisberger, Seattle, Wash. App. filed Jan. 26, 1903. A non-conducting diaphragm is thrust between the separated contacts at the moment the circuit is broken.

739,685. THERMOSTATIC ELECTRIC CIRCUIT CONTROLLER; Christian Klopfanstein and Godfried Klopfanstein, Utica, N. Y. App. filed Jan. 15, 1903. Details.

739,741. APPARATUS FOR MAGNETIC SEPARATION; Benjamin H. Sweet, Brooklyn, N. Y. App. filed June 14, 1902. Magnetic cylinders arranged successively in the path of movement of the crushed ore, are driven at different speeds and are arranged with respect to each other and to various receiving compartments in a manner to effect good separation of the materials.

739,776. CONTROLLING ELECTRIC MOTORS; Harold W. Buck, Niagara Falls, N. Y. App. filed Nov. 17, 1900. The valve of an engine driving the generator is controlled automatically when a rudder has been moved to a certain point by a motor, which point is predetermined by the position of a switch-operating handle.